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A MAGAZINE

Devoted to Science, Engineering, and the Mechanic Arts,
Especially on the Pacific Coast.

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IMPRESSIONS OF A MECHANICAL ENGINEER AT THE WORLD'S COLUMBIAN EXPOSITION.*

BY GEO. W. DICKIE, Mem. Tech. Soc.

During the passed two years or so, all the great channels, as well as the little streams, that carry the thoughts of writers to the reading millions, have been swollen to flood height by World's Fair literature, presenting to the public mind and eye the great Chicago Exposition.

The best writers of the day, assisted by the best artistic skill and the wonderful development of the printer's art, have combined to make the White City by the Great Lake familiar to many millions who either had not the time or had not the means to make a personal acquaintance with this mighty assemblage of nineteenth century industry and art.

In endeavoring to give you in a simple way the impressions I received as a mechanical engineer seeking for new inspiration in his own field of engineering, it will be understood that I do not wish to speak for the mechanical engineer as a class, but only for myself. This privilege being granted, my task will be a simple one, as it will not be necessary to consult authorities or quote the opinions of others.

*Read before the Technical Society of the Pacific Coast, Dec. 1st, 1893. Reprinted by permission.

The principal attraction drawing me to Chicago during the hot month of August, was the Engineering Congress held during the first week of that month in the Memorial Art Palace. My impressions of the Congress will, therefore, be first in order, and as I am to speak only for myself, these impressions will apply only to the section in which they were received—that of marine and naval engineering, except a few thoughts suggested by the formal opening and closing meetings, attended by all sections.

My first impression on entering the Hall of Washington at the opening session, was that of astonishment at the number of eminent men in our busy profession who had found time to come from all parts of the world to attend these meetings; and then the spirit in which the opening addresses were given by those representing the great engineering societies, was an intimation that no one expected to be a teacher there, but that all had come together to learn things that they had not known before, from the experience of others. I was thankful indeed to be a unit in such a gathering, and also to find that although we, in San Francisco, are far removed from the great centers of engineering enterprise, our work is known and appreciated by the leading engineers, especially of Europe.

As a member of the American Society of Mechanical Engineers, my place naturally would have been in Section B, had not Commodore Melville, the present Engineer-in-Chief of the United States Navy and chairman of Section G, enlisted me to work for his section. This was fortunate for me, if not so for this section of the Congress.

There being at that time no organized society in this country especially devoted to marine engineering and naval architecture, gave to the deliberations of this section a wider scope than would have been possible if restricted to the usual society proceedings; and the fact that the work done at the meetings held by this section is to be published and sold on its merits, brought out the best efforts of the best men in the profession.

The proceedings were enriched by papers from such prominent men as, Sir Nathaniel Barnaby, Dr. Francis Elgar, Albert E. Seaton, Casimiro De Bona, B. F. Isherwood, Prof. W. Riehn, Nelson Foley, Nabor Soliani, James Howden, Henry Renbow, J. Harvard Biles, Archibald Denny, and many others.

I had some fear that my boldness in presenting a paper giving my views on certain matters connected with war ships, and my presence in such a gathering, could only result in a humiliating

sense of my own littleness in such an assembly. This fear, however, was very soon dissipated. These men who had been doing so much for the advancement of a great art, were pleased to listen to the experience of one who had been trying to work out some problems in a far-off, out-of-the-way corner on the Pacific. This willingness of those who were leading in the great centers of engineering activity, to discuss with and profit by the experience of those who were working out the same problems, but under vastly different conditions, impressed me with a sense of the value of such meetings. To me it was very encouraging to think that the labor I had often thought was thrown away and little appreciated where it was expended, was not all in vain, but had its effect and produced results where the laborer thought himself entirely unknown.

The one thing that impressed me most during the meetings of our section of this great Congress, was the way in which the subjects treated of in the various papers would broaden out and assume dimensions under discussion far beyond the scope of the original paper. The ideas expressed in a paper produced in a British seaport, when discussed by a marine engineer or ship-builder whose experience was limited to the practice on the Great Lakes or rivers of North America, had to meet conditions and be compared with results that were not only new, but in many cases very startling to the author.

One day during the discussion of a paper on river steam-boat practice, I was endeavoring to point out the advantage of compounding stern-wheel engines, recommending tandem compounds on each side, either condensing or non-condensing, when the author of the paper remarked that first cost was the most important consideration in the construction of a western river steam-boat; efficiency or durability being of secondary importance. "But," said I, "the every-day expense of running must be an important matter, especially where transportation was effected so cheaply." "Why," said he, "I am afraid that the gentleman from the Pacific Coast has had but a small experience with western river practice. As an example of economy let me give you an instance of a freight stern-wheeler in my district that made her daily runs for the last season of eight months on a total expense of \$2.25 for fuel, and this expense was caused by the carelessness of the crew one night not securing wood enough for the next day's run, necessitating the Captain's buying enough to last until dark, as his method of taking on fuel would not work in daylight. In this case what would be the advantage of compounding?"

We had not considered the subject from this standpoint, and had to admit that such conditions would not justify more expensive engines to save fuel.

This meeting of marine and naval engineers at Chicago was to my mind a most remarkable gathering, as being held far from the seaboard, yet on the shore of one of the mighty fresh water oceans of this continent. These men from Europe full of the problems involved in building ocean greyhounds or mighty battle-ships, met men that were solving the transportation problems of the Great Lakes. For the first time the magnitude of these problems and the skill that had solved them would receive attention from those who had been too busy with their own schemes to give any thought to what was going on in the heart of this continent, and I venture to say that this meeting together of ocean and lake practice in ship-building will have its effect and the result will appear in modified types of naval architecture, both on ocean and lake.

The general closing meeting of the Congress was very interesting. The chairman of each section gave a short account of what had been done in his division; and the representatives of foreign societies told us what they were going to say about us and the things we do when they get home. And so we parted after a week of honest work for the good of the profession.

During the Congress I had devoted but little time or thought to the Exposition, beyond spending the evenings inside the grounds, and I must say that these evenings have left in my mind the best impressions I have retained of this wonderful aggregation of human art and industry. On the electric launches inside or on the steam launches outside, sights were obtained that have left a lasting impression, and produced effects on men's minds that cannot fail in modifying thought and stirring into life a more general desire for more artistic surroundings, both in public and private enterprises, than have hitherto prevailed in this country. My first thoughts were that much money and art labor had been wasted on what at best were but temporary coverings for exhibits, and that the impression produced would soon vanish like that of a dream. These first thoughts soon began to take on the modifications that come with more mature reflection, until the impression finally settled into my mind and there remains, that the Columbian Exposition was an inspiration born of a great necessity to rouse the American soul out of the dead level of utilitarianism and breathe into that soul a love of the beautiful. No one could look into the faces of the many

thousands of homely American men and women, not representing the wealth and beauty of this great republic, but the brawn and muscle from her fields and factories, and not be impressed with the fact that new ideas and higher aims were beginning to take shape there. This exhibition of beauty in form and richness in art, will have a lasting effect in the minds of the great masses of this country. A love of the beautiful and the true in form has been implanted in the hearts of many thousands throughout that portion of this country where it was most needed. The humble homes throughout the land will feel the touch of that influence and a regeneration will be the result that I trust may reach things mechanical as well as things architectural. That the mechanical mind of the present day has successfully divested itself of all sense of the beautiful, is abundantly proven by the fact that so many hideous mechanical contrivances were exhibited within these beautiful structures.

As the impressions I am trying to describe are those of a mechanical engineer, the best place to receive these impressions was the Machinery Hall, and so for the first two or three days I devoted the working hours to the contents of that great and beautiful building.

In making a general tour through this vast assemblage of driving and driven machines, I was first impressed with the hopelessness of trying to make any intelligent, systematic study of any type of engine or machine exhibited. This was largely due to the method of arrangement that had been adopted. Exhibits were grouped in the spaces assigned to the various countries which produced them instead of being grouped in the classes or types to which they belonged. This, to me, was very perplexing, it being impossible to compare the merits of any one exhibit with a similar exhibit of the same class but of a different country.

I endeavored one day to reach some decided opinion as to the merits of the various examples of vertical engines adopted for driving electric generators direct, but found that after taking a mental inventory of the good points in one set of engines, the photograph that I had tried to carry in my mind to a remote corner of the building where another such set of engines could be found, was by reason of the many intervening things demanding attention, completely obliterated. I had, therefore, to abandon any attempt at comparison between exhibits and simply wander around, noting only such exhibits as at first sight produced a very good or a very bad impression, and, striking a balance, arrive at a general impression of the whole. The result I am sorry to say, was disappointing.

Here the electro-mechanical engineer had it all his own way, but this splendid opportunity was allowed to pass by unimproved of establishing by a practical demonstration under what conditions it is economical to convert mechanical energy into electrical energy, and carry it by conductors to the various machines of a factory, and there convert it back again by means of electric motors into mechanical energy.

When I tried to compare the number and power of engines driving generators with the number and size of machines driven by electric motors, there appeared to me to be an immense loss of energy somewhere, and it was disappointing to find no means to prove whether the impression produced was true or false.

The steam engine exhibits at Chicago confirmed an impression that for years has been forming in my mind, that the prime mover which has done so much for the advance of civilization and material wealth is not now held in the same veneration as in years gone by. Designers, builders and owners now treat the steam engine no better than they would a lathe, a planing machine, a loom, or a printing-press. Democratic ideas at present prevail in mechanics, the declaration has gone forth that all machines are equal, and by right are free to perform their functions with the least possible expenditure of material carefully disposed in the direct lines of strain, no matter how offensive these unclothed skeletons may be to those who remember the time when the steam engine was the master machine, had a splendid house or palace for its own use, had a dignity of its own apart from and above the factory to which it imparted life and motion, and when its owner died or gave up business the great engine went as part of the land and buildings, and not as a mere manufacturer's implement.

I looked in vain for some trace of the dignity of form and proportion and the grace of motion that characterized the factory engine of twenty years ago; the massive finely moulded base; the correctly proportioned columns and rich entablature, with the cylinder or cylinders so encased in polished mahogany as to be in harmony with the other statical parts of the structure, and all this, filled in with the artistic tracery of parallel motion and connections, making a complete machine that gave satisfaction to the soul of a true mechanic. With what is modern mechanical science, hampered by the all prevailing desire for something cheap to serve a present purpose, replacing these stately monuments of mechanical genius?

Here is what I found as the modern development of mechani-

cal science. A square box called the high pressure cylinder, close behind it a larger square box called the low pressure cylinder, and usually a round box on top with a leg in each of the other boxes called the receiver. Between these boxes and the shaft journal in the line of tension and compression strains, either steel rods or straight castings are fitted of just such form and dimensions as will resist the strains produced when the thing works.

Now these lines may be perfectly correct and just the proper amount of material may be disposed around them, but I claim this to be an indecent exposure of the design. The disgusting nudity of these miserable machines, is not the nude in art as we find it in the Art Building, but rather naked skeletons of the anthropological exhibit. This setting up of the bones of a design as a finished result, denoting the presence of science without art in mechanics, produced on me a most painful impression, which deepened into actual shame that our profession had made such an unworthy exhibition of its own decadence.

I am often told that the useful only should be retained in any design. That is true, but who can say what is useful? Your best poet says :

"Nothing useless is or low,
Each thing in its place is best ;
And what seems but idle show
Strengthens and supports the rest."

What would the beautiful building be that shelters these miserable mechanical skeletons without its clothing of staff? What hideous spectres would have surrounded the Court of Honor, if only the actually useful had been allowed a place? In regard to our other surroundings, we are not satisfied with the bare necessities of existence, and why should we be so in mechanics?

One of the conditions resulting from this utilitarianism is the sameness of design by all makers of certain types of engines. They could only be identified by the name plates, and were entirely without character, and are to mechanical art what a chromo is to a painting.

This condition is very distressing when we come to follow these mechanical contrivances to the permanent positions they are to occupy in factories or power stations throughout the country.

I must say, however, that in the various Eastern power stations that I visited, the engine designs as a rule were far more satisfactory than those exhibited at Chicago. In giving you the general impressions

produced on my mind by the steam engines exhibited, I must make one or two exceptions, notably a set of vertical engines for driving electric generators exhibited by a German firm, the satisfactory proportions of which did much to relieve the distress produced by the American horizontals. It seems to me that the modern idea as to form in mechanics is limited to what a planing machine can produce in flats, and a self-acting slide rest lathe can produce in rounds.

In my younger days when material not essential to the working of the machine had to be filled in between two points, the instructions given on the drawing were to make the part eye sweet, thus leaving something for the artistic character of the workmen to develop, and I know from experience how these little opportunities were improved by the true mechanic.

Before leaving the matter of engine design as displayed in the exhibits at Chicago, I desire to call attention to the prevailing indifference manifested by engine builders, and those who employ them, as to whether their designs are in keeping with their surroundings.

While East I visited a great many power stations, and in no case could I trace any relationship between the engines and the structures that sheltered them; in fact, as a rule, the designs were entirely opposed to each other. In one city I found a very pretty Gothic building sheltering a very ordinary horizontal pumping engine. The house was a thing of beauty, displaying true artistic skill in its design. The machine it sheltered was — well I hope for the sake of my profession that it was bought in some machine junk shop, and not designed for the place it occupies.

In another city I was driven to the water works, and on seeing the buildings my hopes ran high, expecting for this once I would find that a master had been there. The engine house was a castellated structure of rough hewn stone, in the Baronial style, the water tower being encased in the same style of stone work with a castellated top like the engine house, and the bronze railings and gates, with their battle-axe terminals, were all in keeping with each other. But with the architect all this unity of design ceased. Within I found two beam pumping engines, very well designed in themselves, but it just occurred to me that the owner of this Norman castle had gone down to Greece and stolen the engines out of some Ionic temple. Another set of engines, in the same building, were of the horizontal fly-wheel type, without any character whatever. Evidently the first two sets of engines were special designs, and if

the designer knew where they were going, and in what kind of a structure they were to pass their lives, why did he not design them so that they would be at home there? What a splendid opportunity to mount a beam on a Norman tower, supported on a rough hewn base, with loop holes for the foundation bolts!

The horizontal things had no business there at all, and as they were new, they only served to show how far we have fallen away from all appreciation of what is good in design.

Coming back again to the Exhibition and to Machinery Hall, I am glad to say that the impressions I received from a general and hasty observation of the varied and extensive display of machines in general, was on the whole much more satisfactory than my impressions relative to prime movers. Machine tools and machines for the various manufacturing operations show, I think, a steady advance, both in design and adaptability to the work. In the Krupp exhibit, which is an annex of Machinery Hall, apart from the fine ordnance shown, there were splendid specimens of smith work and machine tool finish. Perfect workmanship is the aim of this great firm, and I know from personal experience that they come very close to it.

The Railroad Exhibit in and annexed to the Transportation Building was, in my opinion, the most important display made at that great exhibit. The arrangement of exhibits was very satisfactory, and the historical grouping enabled the student to trace the process of development that has resulted in the present speed and luxury of railroad travel. In design the locomotive has steadily improved. It is a more sightly machine to-day than it was several years ago. Correct form and well balanced proportions are depended upon now to gain respect for the machine at the front of a railroad train, instead of the bright brass rings and gaudy paint, which characterized the railroadster of twenty years ago.

Compounding the locomotive is gaining favor, if one may judge from the number of this type that were shown in the Transportation Building.

In passenger coaches the utilitarian ideas that I noticed as so all-pervading in engine design, had no place in those exhibited at Chicago. With utility was combined beauty of outline and artistic finish in a very high degree.

The display of models by the great ocean transportation companies and ship-builders, especially those from Great Britain, was not only fine and very expensive, but also exceedingly interesting and instructive. Here the student of naval architecture could trace the

progress of his art from the time when man first "went down to the sea in ships" and did "business in great waters," to this day, when the phantom of steam propels our ships whether the phantom of wind is with us or against us.

Progress in ship-building and marine engineering has been rapid during the past twenty years; and if the universal desire for things cheap, which affects transportation as it does everything else, does not paralyze the efforts of those who are ready to go on to greater achievements, we may look for grander results.

The Transportation Building, with its contents, was to my mind an ideal exhibit, and had there been nothing else at Chicago it would have been a great exhibition.

It is not my purpose to attempt giving the impressions produced on my mind by the displays that attracted my attention in the various exhibition buildings; in fact I have already given you the impressions that I desired to convey in this short address. The Chicago Exhibition was too large, and I trust that in this respect it will never be equaled.

I made several attempts to take in the contents of the Electricity Building. Electric science in its many applications to mechanical work is but a youth, and at present I think is sowing its wild oats. When it reaches the years of discretion it will, no doubt, admit the folly of many things that it now thinks there is great fun in doing. There were many fine exhibits in this building, but, as I have said, the electrician is young, and in some respects just a little foolish. The material he works with is full of tricks and lends itself readily to the show business, and so the Electric Exhibit was largely spectacular, which to the crowd was very grand, but to the mechanic, seeking for new applications of the subtle fluid in transmitting energy to the various mechanical operations he has to deal with, less show and more of real work would have been better appreciated by him. But in this I may be mistaken. Certainly no mechanic could have helped being impressed with the wonderful advance that has been made in a very short time in the science of electro-mechanics. Nothing in the history of human progress equals the rapid advance made in the application of electric energy to all the activities of modern life. In the production of electric energy and its utilization lies the richest field for cultivation by the mechanic of to-day. It is the most elegant agent for the transmission of power that science has presented him with, and I have some hopes that through this agent a revival of artistic taste may be looked for in the product of mechanical engineering.

There was one exhibit that impressed me more favorably than anything that attracted my attention at the Exhibition. That was the Swedish National Exhibit. Within that modest building there was grouped more of what I considered real mechanical art than in any of the other exhibits that made more pretense. In iron and steel, and pottery work, this exhibit was a demonstration to me that there was at least one place where the master-mechanic's hand and designer's pencil had not yet lost their cunning. The work was full of character, showing that the smith had hammered some of his own soul into his forging, and the finisher left something of his own refined character on the surface of the metal.

Elsewhere it seemed to me that I had been wandering around in a mechanical wilderness, the machines being as like each other as the clumps of sage brush ; but here, in this little bit of Sweden, it was like leaving the wilderness for a trim little flower garden, where each flower was trained for the best there was in its own individual self; the true workman doing his work lovingly and putting his own self into the product of his hands and brain.

This is the quality that we lack in our mechanical work, resulting in a sameness without character, able enough, perhaps, to do the work for which it was designed, yet without any characteristic feature to command the attention and respect of the beholder.

One of the saddest things I heard at the Engineering Congress was a remark made by the chairman of the section representing the American Society of Mechanical Engineers, in which he held that the day for mistakes being made by mechanical engineers had gone by; technical education had given the mechanic the means to calculate the result required and the means to reach it, and that now improved automatic machines produce the valve gears of steam engines in interchangeable form, so that any engineering concern can buy from a valve gear factory the wherewithall to make his engine run with the best. And so we find the cow running around with a horse's tail, and pretending on that account to be a horse.

Not long ago the town of Dumbarton, Scotland, erected a monument to Robert Napier, the engineer who had done so much to introduce steam for ship propulsion, and nothing better could be found to represent this man and his work than the first steam-ship engine he built. So the old engine has been mounted on a granite base, as a fit monument to the man who had taste as well as skill as a mechanic.

How would the engines we are now designing and building do for monuments to show to future mechanics the evolution of the steam engine?

DISCUSSION.

PRESIDENT GRUNSKY.—“We have been delightfully entertained by the glimpse Mr. Dickie has given us of Chicago, particularly of the machinery there, and we would be pleased now to hear from any member of the Society who is willing to open the discussion that I am sure Mr. Dickie will further participate in.”

MR. RICHARDS.—“I will venture to say a few words to open the discussion. I am hardly able to ‘absorb’ the æsthetic part of Mr. Dickie’s remarks. His criticisms in the main are just, and I will confine the little I have to say to the most salient part of his paper, the modern steam engine in the United States and elsewhere, where the high-speed designs have been carried. I think his criticism in regard to these are correct. Under utilitarian ideas modern high-speed engines have been given an uncouth skeleton appearance. The first tendency in that direction was when our great and honored designer, Mr. Corliss, set his steam engine up on ‘legs.’ That new departure went all over the world, a great compliment to him. I am not speaking of his valve motion and steam distribution, but of the frames of his engines.

This disregard as to the symmetry of steam engines has always seemed to me to be wrong, and not in good taste, and I hope some day it will pass away. Formerly the foundation and frame were made parts of one structure, such designs were graceful and attractive to look at. But when engines are set up on ‘legs’ they are the opposite. In one of the electric-lighting stations here we have a large engine of 500 or 600 horse-power that was made in Milwaukee, one of the utilitarian kind, almost without a frame; people go around it and do not want to see it.

It is not altogether a money matter or a saving of material. Everything connected with an engine should harmonize. Some of the highest types of steam engines in the world can be found among our own, such as are used in some of the large manufacturing mills. In the cotton mills in Great Britain, also, the best types of engines are used. The designs of Sulzer Bros., of Winterthur are excellent; so, also, are those of some Continental makers in Germany and Belgium, but these are not of the ‘skeleton’ type.

The adaptation for electric generators in this country has called forth a type of engine in which regulation was the first consideration, and the next high speed, and there being considerable competi-

tion in this direction in the way of price, the frames in many cases have been made in an unnecessarily uncouth form.

Mr. Dickie's criticisms of machinery shown in Chicago are severe, but I think just; but, unfortunately, a great many of our largest and best makers of machinery in the United States were not represented there at all. Two principal machine making firms, those most capable of making a proper display in Chicago, did not appear there at all. I allude to Bement, Miles & Co., and Wm. Sellers & Co., of Philadelphia.

Among the high-speed engines, one possessing the most celebrity, and which would, no doubt, have been awarded a first prize, is the straight-line engine of Prof. John E. Sweet. This engine is a study; like all he has made, it has marked peculiarities. It was not exhibited at Chicago, and I am afraid it was not there because of some unfair influences being set at work to prevent it being exhibited.

The principal maker of woodwork machinery in the United States, I don't mean the largest maker, but the one who does the best work, and the only one who could have made a high display of good fitting, sent no machinery to this Exhibition. He exhibited in Paris at the first and third Exhibitions there, and was awarded gold medals by the French Government. He exhibited his machinery at Vienna, and received a gold medal there. He has taken his machinery all over the world, and has constructed no less than two or three hundred machines for special use abroad, of which I have personal knowledge, all of the highest class.

There are some machines of his in the Union Iron Works in this City. I allude to Baxter D. Whitney, who of all others, could have best sustained the high character of our wood-cutting machinery at the Exhibition.

Perhaps I had better state the reason, as long as I am reflecting on the management. He prepared an exhibit at a great deal of expense. The drawings and the plans were all arranged, and after some time had elapsed he was informed that he could have "thirty feet square" in which to set up his machinery. Of course he did not set it up. Prof. Sweet was treated in the same manner.

So we must make allowance for Mr. Dickie's criticisms by considering things that were not at the Exhibition. My old firm in Philadelphia, makers of certain kinds of machine tools for wood and iron, of the heavier class, had nothing in Chicago that I have heard of. So the exhibit of engines there may not have been representative of practice in this country."

MR. BESTOR.—“While I was at the Great Fair, I had but a short time to spend amongst the machinery, but I noticed that want of art in the design of the machines, to which Mr. Dickie alludes. I expected to see some of the best machines the world produced. They all looked to me like machine goods.

There appear to be two periods of art work; the first is that which is constructed by hand, which you may select from every form. When machines come in, the work looks crude and stiff, and very much alike. As machines are improved, the work they produce is correspondingly better and more artistic. It seemed to me as if the exhibited machinery was in the first stage of machine-made articles.

Mr. Dickie's views are very much the same as my own, in so far as the subjects treated.”

REJECTION IN PATENT CASES.

We have several times, and at length, pointed out in this Journal the inconsistency of “rejection” by examiners in the U. S. Patent Office, placing on them an onerous and unnecessary duty, and delegating a power which even a Federal Court does not possess. Since our last article on this subject, it has come up at various times, and always with strong support of the views we have urged. In the last month, Mr. C. D. Davis, of Washington, in a letter to Mr. Lloyd Wise, of London, has used the following words :

“I especially approve your suggestion that the official examiners should not be permitted to pass upon the question of utility and patentable novelty from documents alone, but that their duty should be limited to requiring the insertion of a disclaimer in the patentee's specification whenever the examiners discover anything of an anticipatory nature.”

At a late meeting of the Chartered Institute of Patent Agents, in London, Mr. Edward Carpmael moved :

“That should any serious attempt be made to introduce any system of official examination into novelty into this country, it is desirable that the Institute should use all its influence to prevent any power over the claims being given to the examiners.”

The resolution had no opposition.

The London Chamber of Commerce some time ago passed a resolution against the American system of examinations being introduced in England, that is, against the feature of “rejection.”

SAN FRANCISCO SEWERAGE SYSTEM.

Last month we barely acknowledged the receipt of a copy of the report of Messrs. Manson and Grunsky, engineers in charge of the work of devising and providing a system of sewerage for San Francisco.

The intention was to read this report and then lay before our readers such facts and excerpts as would be of interest, but we find an impediment to this in two reasons. The investigation of physical data in respect to a complete system cannot be made compendious enough for such purpose, and we must only remark upon its careful character as far as completed. A second reason is, that the main part of the report, which relates to the present sewerage, does not need further publicity. It should be buried in oblivion.

This example is not required to show that the city may be robbed and outraged by pretended public service. People will again and again pursue the same methods that have caused such wrongs. Messrs. Manson and Grunsky have taken the precaution to photograph underground work in a number of cases, to prove beyond cavil that it is bad and useless for the intended purposes, performed by dishonest contractors, passed by venal inspectors, and instead of furnishing wholesome draining, constitutes a system of traps for filth.

As remarked, there is little use in exposing what exists under the ground in so far as any moral effect or reform of the system. Everyone knows or suspects all that can be said, but this is the menace to life and health which may move people to some new action which it seems will have to be in the form of a new charter to correct the evils of administrations.

Messrs. Manson and Grunsky are not a whitewashing committee. They are professional men not depending on politics or public service for business, and their selection for this work grew out of the spasmodic wave that included Colonel Mendell, Professor Davidson, and Mr. I. M. Scott in a commission to devise a sewer system. This wise and judicious cause soon succumbed to "politics," as had many previous schemes to reach something better. Mayor after Mayor, also health officers and other professional authorities, have protested against the sewer system and the system by which sewers are constructed. The present report includes a great many of these protests, some of them startling. Of the present executive method the engineers remark :

"To the engineering profession the explanation is due in this connection that the office of City and County Surveyor is an elective one, that party politics can be relied on in San Francisco no more than elsewhere to consider qualifications for office a prerequisite to election, and that the responsibility for all sewer work has fallen partly upon the Surveyor and partly on the Superintendent of Streets. Without such explanation it would indeed be difficult to account for the persistent lack of endeavor to effect a reform."

We are not among those who contend that sewer construction should be managed by scientific men. To "devise" a sewer system calls for the highest scientific skill available and the counsel of different men, but execution of the work depends upon "honesty."

The specifications for City sewers are all right if observed and followed, and it does not require a very high grade of skill to detect improper work, so the whole is narrowed down to a comprehensive scheme, and honesty in construction.

For the want of some complete system, and by imperfect work, at least one half of the \$5,714,225 expended for sewers is lost, and the objects of the sewers such as we have, are not attained.

It is not difficult to see why the engineers have thought it worth while to turn up this rascally underground work to the light. It was not incumbent on them to do so, and few would have had the fortitude to do it, but they well knew that the menace to health and life was the only force to be relied upon for reform. They also knew that such an exposal would terminate their own official service as it has done, and the Commission to Devise and Provide a Sewer System for San Francisco is no more.

Messrs. Körting Brothers, the well-known "induction" engineers, have sent the following to the editor of *Engineering*, respecting a test made of a "pulsometer" pump, in July last, at Hanover, Germany :

Height of suction.....	11.27 feet.
Total height of delivery.....	102.6 "
Horizontal length of delivery pipe.....	118 "
Quantity delivered per hour.....	24,188 gallons.
Weight of steam used per hour and per pump H. P.....	92.76 lbs.
Work done per pound of steam	21,345 ft.-lbs.

This far exceeds any results attained here, but even at that, is three times what would have done the work with a common pumping engine.

THE LINE AND THE STAFF.

The controversy between the line and the staff is one of the principal facts concerning not only our own but the navies of the world at this time. Naval warfare has changed ; like certain manufactures it has become a " machine process," so to speak, in which the " line " has to find where a ship is ; to keep her off the shore, and direct her course. Her destructive functions are a problem of machinery, and this again of the management of the machinery. We can not, however, add anything to the presentation of this matter found in Commodore Melville's last report, from which the following excerpts are taken :

" There are at this date one hundred and eighty commissioned officers on the active list of the engineer corps of the navy, viz : seventy chief engineers, sixty-six passed assistant engineers and forty-four assistant engineers. There are in addition eleven engineer naval cadets, of whom one is in Paris studying naval architecture with the expectation of being commissioned an assistant naval constructor, and ten are at sea performing the service required by law prior to their final graduation from the Naval Academy. Four of these young gentlemen will become assistant engineers in June, 1894, and six a year later. Their duties in their present grade are not of a definite nature, but consist principally in study and such minor duties as may be assigned them. Seven assistant engineers commissioned in July of this year are receiving instruction intended to supplement the academy course and to better fit them for their duties as engineers. From the above number must be taken those who are sick, those on the customary leave of absence at the end of a cruise, and those unavailable from other causes, leaving a number entirely inadequate to the existing and rapidly increasing requirements, and unless something is soon done, our navy, now practically an engineering one, will be crippled for want of engineers.

This question of the sufficiency of engineers in the service is one of paramount importance, and no other, if left in abeyance, will so vitally affect the efficiency of the navy as a fighting organization. It must be remembered that the efficiency of the modern war ship, either as a fighting machine or as a commerce destroyer, depends wholly and absolutely upon her machinery, and the efficiency of this machinery upon the skill of her engineers and upon the diligence exercised by them in its care and management. Be her armor and armament the most powerful, and her commander the most capable and intrepid, if her machinery fails she is helpless, and no amount of seamanship or gunnery will avail against the enemy.

Were the navy a mercantile concern the present state of affairs would not last beyond the time necessary to change it, for men with

capital invested in machinery see to it that there is a force sufficient to keep it in proper maintenance, and surely if business people find such a course economical the Government cannot do better than follow their example. The value of the naval machinery now owned by the Government, and in process of construction, is about \$24,000,000, and it has now come to the point where Congress must decide whether it is more economical to properly care for this machinery and keep it always in an efficient condition, or to let it run on as long as it will and then replace it, taking meanwhile the risk of having it fail when most needed. As an illustration of the increased work thrown on the members of the Engineer Corps by the acquisition of the new navy, I can state that the *New York* has added 17 per cent. to the horse power of the machinery of the vessels in commission, the *Columbia* will add 17.3 per cent. more, and when the ships now authorized and building are finished the horse power of the propelling machinery of the navy will have increased to nearly *two and a half times its present amount*—and yet we are asked to run it with the same number of engineer officers that we now have. * * * * *

Coming now to the question of conferring positive rank instead of the meaningless 'relative' rank now held by members of the Engineer Corps, I earnestly trust that the Department will recommend to Congress some measure looking toward this just and proper recognition of the service performed by the officers of this corps. Why officers devoting their lives to the service, who have always had a certain portion of the crew to organize, muster, discipline, station and drill in the various maneuvers intended to make the vessel efficient and destructive, and who from this time on will have under their control from 25 to 60 per cent. of the entire ship's company, should be denied recognition as a military element in a fighting organization would be incomprehensible to anyone not familiar with the inside workings of the navy.

Outside of a few people in contact with the navy through business or friends, the country at large knows or cares little about the navy's methods; it pays for and wants a navy organized on sound principles—that is about the extent of its thoughts about it. Were the facts clearly understood I believe that Congress would soon furnish a solution, since the thing asked for costs nothing, usurps no command, and would put questions of rank in the navy on a uniform basis with that in the army. The engineers ask for no authority outside of their own department, they only ask such recognition within it as any person should have who takes the risks and bears the brunt of battle, and who directs the operations of men during it; in other words, they ask Congress to legalize the functions they now perform.

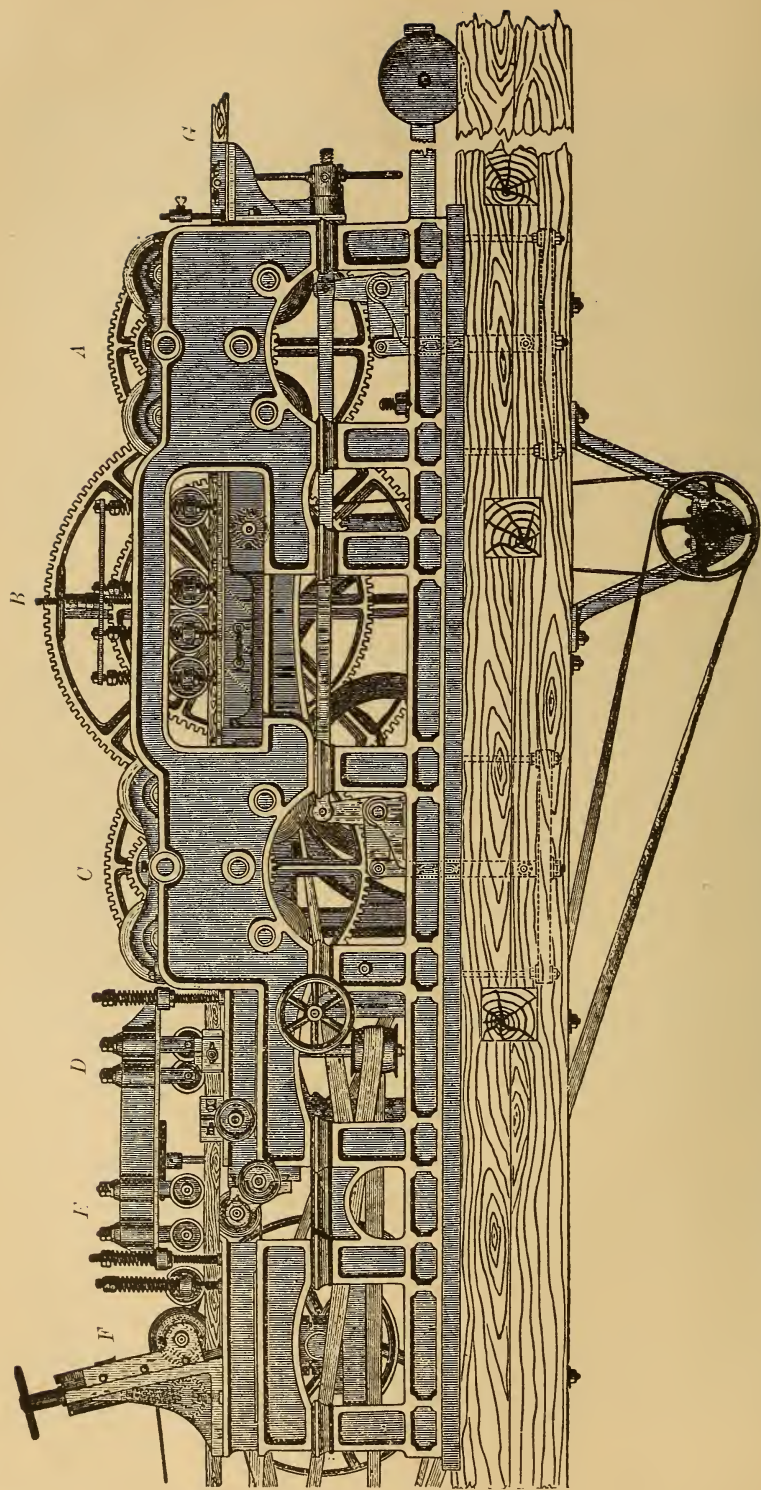
Engineers have been and are being continually spoken of contemptuously as 'non-combatants;' the engineers resent these assumptions of those who arrogantly claim all fighting duties, and no cunning evasion or perversion of facts, no statements to the effect

that the engineers are influenced by 'sentiment,' and that they aspire to command ships can draw attention from the fact that the engineers of to-day are 'combatants' in the strictest sense of the word, and that as such they should receive proper recognition. The naval battle of the future will be a thing of horror and of sudden wholesale carnage, if nerve directs; the ship will fight with her engines as well as with her guns, and the ram will be a more dangerous weapon and one more feared than the battery, and if her boilers or her engines fail she will become a drifting mass absolutely at the mercy of the enemy.

Let those who decry the engineers as 'non-combatants' take home the lesson to be learned from the loss of the *Victoria*. It was not powder that there worked destruction—it was steam; and if such horror can occur in peaceful maneuvering what might not happen in time of battle? Here is a ship lost under the exact conditions of battle—rammed by another—and see how the 'non-combatant' engineers came out of it. 'The whole engine-room staff on watch perished to a man.'

* * * * *

Human mind cannot imagine a position of greater nervous and mental strain than is endured by men who in battle are fastened in these death traps. If ever discipline and command of men is needed, it is right here. Surely the man who, at a critical moment, by his nerve, training, and sense of duty and responsibility, keeps these men at their stations, and makes of them a fighting factor that can be absolutely depended upon should be recognized as commanding them, and that by something more than sufferance and the honorary compliment of 'relative' rank. It is much easier to control men where they have their danger constantly in sight, and where, if necessity compels, they can jump and save themselves, than it is in an air-tight fire room and beneath the battle hatches of an engine room, where the rupture of a steam pipe from any cause means death to all in the compartment. And the officers who do this, and successfully aid the captain in carrying out his plan of battle are fully as important and deserving of just treatment as the officers who control the gun's crews and direct the fire of the guns as ordered by the captain. It is a question of men and ability, not one of corps prejudices."



NORWEGIAN WOOD-PLANING MACHINE. — JENSEN & DAHL, CHRISTIANIA, NORWAY.

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NORSE WOOD-PLANING MACHINE.

The opposite engraving, for which we are indebted to the courtesy of *The Woodworker*, is a side elevation of a wood-planing machine, by Messrs. Jensen & Dahl, of Christiania, Norway.

It is typical of the machines employed for making flooring, ceiling or other dressed timber in the Scandinavian countries, and we may say in Northern Europe generally, and in England, where the machines made by Messrs. Thos. Robinson & Son, an extensive works at Rochdale, are nearly identical.

The machine seems a wide departure from practice in this country, and is so, both in respect to arrangement, manner of operating, and results, and we think there is a good deal in it to demand serious attention here.

Before proceeding to explain the machine, it will be proper to point out that the method of planing shown is essential there. It is not another way of performing what American machines do, but is something else. Flooring, ceiling and all other dressed joiner work for the markets of Paris, Vienna, Hamburg, London, and other European cities, must be "smooth," and thoroughly smooth. All flat surfaces must be finished with fixed cutters that are arranged like a common hand plane with caps on the knives, and two to three cutters, one following the other, taking off a thin shaving, leaving the surfaces the same as what we call hand smoothed, only more perfect than hand work.

Flooring boards are seldom made with tongues and grooves, because they are nearly always laid double and keyed up, so as to be thoroughly tight. The tongue and groove is looked upon as a cheap expedient pertaining to second-class flooring. As both the sides and edges are finished with fixed knives there is no limit of speed, and the feed or capacity of one of these planing machines is almost unlimited.

Twenty years ago when we visited the works where the above machines are made, it was a matter of much astonishment to find a feed of 90 feet a minute common for flooring. At that time the rate of speed in this country was about one half as much, and while it is more now, owing perhaps to an increase of cutter speed and other causes, no machine with rotary cutters only can operate in competition with those having fixed cutters. This is one feature of the machine here shown, but the main difference from our methods is in

arrangement or sequence of the processes. These we will now attempt to describe.

The rotary cutters, five in number, are all driven from one countershaft at the left or rear end of the machine. The timber is fed in at *G*, just the reverse of an American planing machine, indeed the operations are all reversed in sequence, as will appear.

At *A* are the first pairs of feeding rollers, four in number, usually about 12 inches in diameter. These drive the timber forward to the section under *B*, where a rotary cutter, driven from below as seen, cuts off the rough "face," the timber being pressed down by a series of small rollers seen on top.

Succeeding this first operation comes the fixed planing knives set in the drawer just behind the rotary cutter before named. This drawer is a fine piece of work, very carefully fitted up, and slides across the machine in accurately-fitted bearings at the bottom and sides. Here one to three thin shavings are taken off in a continuous web, which is commonly led down into a pit beneath, and from the toughest class of fir can be twisted into ropes, and made into mats or such like, which are often colored and sold as an article of manufacture.

At this stage the timber is merely faced true on one side, which becomes a "gauge" surface for future operations, the same as in planing up pieces by hand, indeed the whole process is analogous throughout to preparing the work by hand. Next comes a second set of four feed rollers at *C*, similar to the first set at *A*, all being geared by spur wheels at the rear side of the machine, and driven by the large wheel in the center.

Succeeding these feed rollers at *C* is a series of staggered pressure rollers at *D*, where the rotary side cutters act. These are similar to what are employed on American machines, except that, as before explained, the knives are commonly flat, so as to make square edges. Next comes fixed cutters for the edges, which are simply iron planes with "capped" knives to take off one, or perhaps two, thin shavings, after which the timber passes under the pressure rollers at *E*, where an auxiliary rotary cutter acts for chamfering, beading, rebating, or for any other work required on the face.

The timber at this stage is planed true, smoothed and squared, the remaining operation being to chip or "thickness" it on the top or back. This operation is a rough one, performed by the rotary cutters *F*, corresponding to the first or main cutter of American machines. This finishes the operation, which is just the same in

making mouldings or any kind of planing on "all sides."

It will be proper to confess that many years ago when we first came in contact with this method of planing it was a great surprise in many ways. The quality of the work and rate of feed was especially a matter of astonishment, but it required a long time to analyze and comprehend the difference from our American methods.

We found throughout Europe, and especially in the northern parts, American machines of all kinds, original and imitated, but not for planing or making mouldings, and no one will ever see planing machines made or used there on the American plan. We had the misfortune once to have sent out to England by mistake an American planing and matching machine of good quality by a well-known maker. It stood for eleven years on sale at almost any price, and then was consigned to Australia, where six years later it was yet "on sale," and is yet no doubt. During this time there was a continual importation of American wood-working machines of other kinds, which found much favor.

Messrs. Bark & Warberg, of Gothenberg, Sweden, on the recommendation of some one not acquainted with the matter, ordered two planing and matching machines from Worcester, Mass., in 1874. Mr. Bark, senior member of the firm, went into the planing mill to see the machines started, and after an inspection called out: "*Tusend djävla* (a thousand devils), you are feeding the machine the wrong way, change the belts and feed the other way. You are thicknessing the timber before you are making the face." When he found the machines could not be fed "the other way" he ordered the belts taken off, and the machines taken out of the mills. They stood for years in a shed, and were pointed out as one of the greatest curiosities.

Now the question arises, why should we, in this country, first thickness the timber and attempt to make a "face" at the same time, which is impossible if a good face is to be produced? Next match the timber, or do profile cutting, gauging from the back of the piece instead of from its face, and this back rough and unplaned at that.

If a board is too thin, splintered or "pulled out," it comes out rough or spoiled on its "face," and not on the back as in the European machines, and when all else is done there is made what should be the face, with a cutter at the rear end of the machine. The same with mouldings. The profile and sides are cut with the piece resting on a rough side that is planed last.

This is a problem that for many years past has been one of much concern, but we have found no solution of it yet. It is unprofitable and discouraging to see all other kinds of wood-working machinery sold from this country for use abroad, except planing and moulding machines and some kinds of sawing machinery; also discouraging, as we have cause to know, that in this City at least no timber is dressed smooth enough to paint on, and one must, to have a decent finish, plane all flat surfaces by hand, as was done sixty years ago.

To increase this problem is the fact that whenever this fault of sequence or arrangement of planing and moulding machines does not enter into their operation, the practice here is good, except as to overfeeding and "jamming it through," as it is called.

This matter of wood planing is, in this country, an anomaly, and among all machine process is perhaps the only one that can be thus criticised and complained of. How it came about and what the reason of its continuance, is one of those inscrutable facts that seem to defy explanation.

MR. CRAMP ON NAVAL ARCHITECTURE.

Mr. Charles H. Cramp, in his late paper on the "Evolution of North Atlantic Passenger Steamers," read before the late meeting of the Society of Naval Architects and Marine Engineers, gives an interesting history of the matter, and the paper is one of much interest, but marred by a provincialism in uncalled for reflections on other shipbuilding firms. In a quotation given below, will be found the slang term "fad," quite out of place before an assemblage of the kind, repeated four times, while his views of the matter lack other practical confirmation than the four vessels of the American line that have been altered over after a dozen years' service. It is a pity to see a paper of the kind marred by such unseemingly allusions to those we have reason to think are quite as skilled as Mr. Cramp can ever hope to be. His special aversions are the "British builders," thus spoken of:

"The principal fad of the great English builders is an aversion to statical stability; a repugnance to metacentric height. As one of their standard authorities remarked in a recent paper. 'A ship will roll; you cannot help that. Therefore the problem is to make her period as long and her motion as easy as possible.'

Even if this be true in theory the practices by which they seek to put it in effect are based upon error.

In pursuit of 'an easy roll' they persistently design their models without initial stability, and then make them stand up by great

quantities of water ballast or other dead weight which pays nothing.

When I undertook the design of the two steamships now building under our ship yard numbers 277 and 278, I avoided this fad at the outset.

As a part of the discussion which followed, I addressed, at his request, the President of the International Navigation Company in writing as follows :

‘Any system of design or construction which contemplates the carriage of water ballast, or other dead weight, not cargo or coal, as an inseparable condition of stability under any circumstances, is radically defective, and should be condemned. Of course every double-bottom ship should be so compartmented that the space may be used as trimming tanks for regulating fore-and-aft trim when desired, but I utterly reject and condemn any system under which they must be viewed as necessary adjuncts to stability.

Under such a system no advantage can be taken of decreased draft caused by consumption of coal or absence of cargo, but the ship must always be kept down to a load draft in order to stand up. This is a purely English fad, and the English designers stick to it with characteristic tenacity. In this, as in many other fads, the English appear tenacious in the exact ratio of the density of their error.’ ”

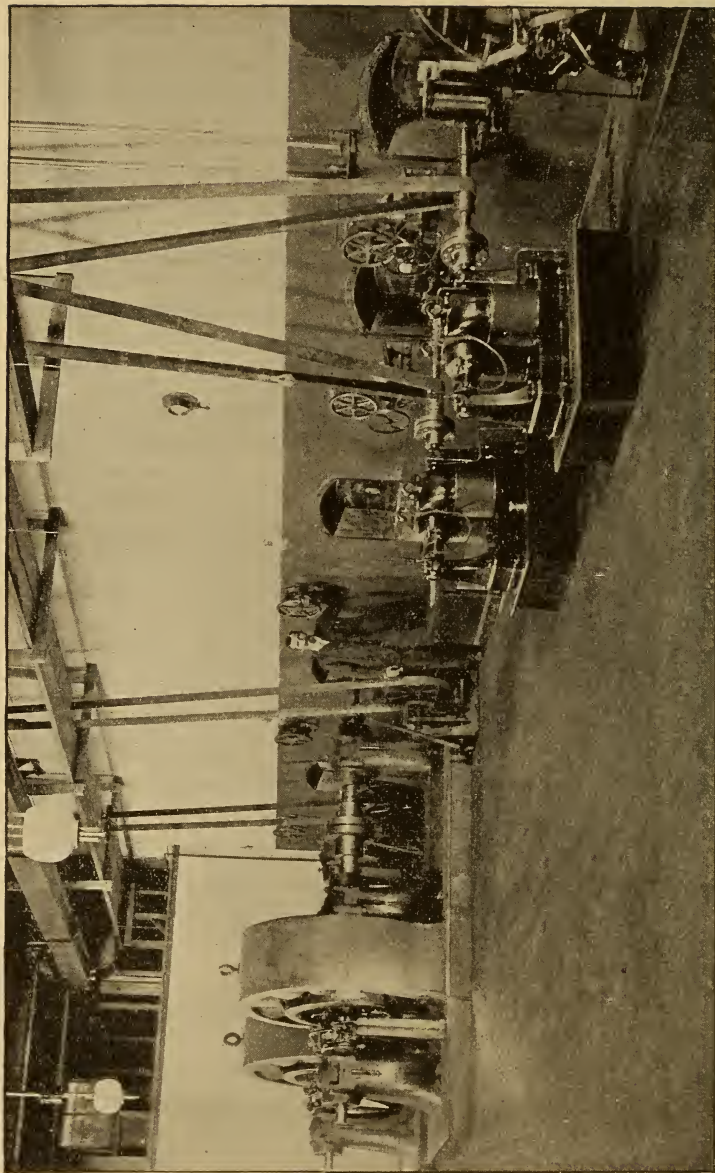
Mr. Cramp should have taken his paper to the Congress at Chicago, and read it before the shipbuilders disparaged, so they could have replied to his criticisms.

There is no information as to whether the French and German built steamers, like the *Touraine* and *Fürst Bismark*, have water ballast or not. If they are not so arranged, then Mr. Cramp was not left to discover the inexpediency of it. If they have such ballast, then it is not a “fad” of British builders alone, but also of French and German naval architects as well.

At the close of this paper, Mr. Cramp says :

“Since we began this work our English friends have had a good deal to say about it. They seem to think that it was impertinence in our part to have entered the contest for supremacy on the North Atlantic.”

We have not had the privilege of seeing or hearing of anything of the kind from anyone whose position warranted attention. As a rule British and other naval architects do not express themselves in this manner. If they had, the services of Prof. Biles could hardly have been secured to assist in the design of the two new ships of which Mr. Cramp “undertook the design,” and speaks in such confidence. We believe the horse power of these ships was vastly increased and other changes made under Prof. Biles’ advice and plans.



THE REDLANDS, CALIFORNIA, ELECTRIC STATION.—GENERAL ELECTRIC CO.

THE REDLANDS, CALIFORNIA, ELECTRIC STATION.

THE GENERAL ELECTRIC COMPANY, CONTRACTORS.

The plate opposite shows the dynamo room of the electric generating plant, recently erected by the General Electric Company, eight miles from Redlands, California, to supply lights and power to that city and to Mentone, at which latter place, four and one half miles from the station, power is furnished for the Union Ice Company.

This, the company informs us, is the first three-phase transmission plant erected in this country, and from a full discription, of which we can only publish a synopsis, it seems to be one of the first of any kind erected on this Coast in a thoroughly permanent and durable manner.

Power is derived from a mountain stream called Mill Creek, which by tunnelling and pipes is conveyed to a cañon where a fall of 363 feet is attained with a supply of 40 cubic feet per second, amounting to at least 1,200 available horse power, the theoretical being 1,650 horse power. This water is applied on wheels furnished by the Pelton Water Wheel Company, of this City, controlled by their differential regulating apparatus and connected directly to the dynamo shafts. The water wheels are set in another room and are not seen in the drawing, the shafts coming through the wall on the right.

The power house is arranged to receive three 250 kilowatt three-phase generators, two of which are in place, as can be seen in the plate, also a dynamo to supply 50 arc lights with exciters and attendant apparatus.

The current is transmitted by two lines, or as the company states it, by two three-phase currents, each composed of three 00, B. & S. wires, one of which, seven and one half miles long, extends to Redlands for lighting; and the other, four and one half miles, to Mentone for operating the compressors of the Union Ice Company, at that place.

This plant is highly creditable to the contractors, and also to the citizens of Redlands who have had the boldness to lead in such a line of improvement, possible in scores of places along this Coast. The Redlands plant has been in successful operation four months, and is worthy of a visit by those interested in, or intending to erect similar works.



LIEUT.-GENERAL BASIL ALTFATER.

RUSSIAN ARMY.

The portrait of Lieut.-General Altfater that appears above was engraved about five years ago with a view to giving some notice of a distinguished foreign officer and engineer, who had made a thorough study of mechanical industry in this and other countries, and by his own personal efforts had accomplished in Russia more than seems possible, even in a space of thirty years.

In 1876, when director of what he calls the "wood department" of the Royal Arsenal, at St. Peterburg, Lieut-General Altfater, then a Colonel of Artillery in rank, visited various European countries, and then came to the United States, examining carefully the various industries and engineering works cognate with his charge in the Royal Russian Arsenal.

His arduous professional duties had drawn upon his vital powers to such an extent that he started out on what was intended as a journey

of relaxation, but which in the end proved not a time of relaxation but of intense activity. His cultivated and courteous manners, with an unusual power of perception, made him friends everywhere, and opened the doors of all kinds of establishments that he visited, so there was, as before said, no rest, but increased activity during his travels at that time.

One object of his observation on this tour was the processes and machines for the construction of gun carriages, for howitzer, field and siege guns, and he purchased in this country a number of machines such as he found applicable, but these met only to a limited extent the special requirements of the case, and on his return to St. Petersburg he prepared preliminary sketches and drawings of a system of powerful machines for setting and condensing the tires and bands of gun carriage wheels, also for boring out the naves and pressing in the brass bushings.

These machines were novel and massive in construction, some of them weighing five tons or more. One was to condense or upset when cold the nave or hub bands on artillery wheels, which on the arid plains of Eastern Russia fell off by shrinkage of the wood. This machine was transported with the army, and was consequently designed in a condensed form. These and other machines, amounting to a whole system, constructed in England under General Altfather's direction, were very successful.

He was rapidly advanced in rank, and about five years later was commissioned a Major General and placed in charge of the whole of the vast national arsenal, situated on both sides of the Neva at St. Petersburg. This increased field of activity and responsibility embraced at the time, and until recently, the construction of ordnance, now removed to the great steel and gun works at Aboukoff, one of the largest in the world.

Last summer, after thirty years of continuous service, the Government consented to General Altfather's retirement from such arduous duty, and conferred on him, in recognition of his services, the rank of Lieut.-General in the Russian army. His health had been declining for years by reason of his arduous services, inducing nervous derangement, that will, no doubt, be overcome by his merited rest, like "a private citizen," as he terms it.

There is a strange interest, amounting to fascination, in listening to and learning the views of people from a distant land when they first come in contact with our skilled industries in this country, especially when such views are coupled with an acute and trained

understanding of the principles involved, and a previous examination of similar industries in other countries. Such interest attached to the visit of General Altfater to this country, in 1876, at the time of the Centennial Exhibition, in Philadelphia, which he visited. He had just traveled over Germany, England and France, and from him could be gained an intelligent and impartial opinion of our machines, processes and methods of manufacture.

It was due to this fact, with the valuable information gained, and to his interest and favorable opinion of American implements and processes, that his portrait was engraved for INDUSTRY in 1888, but he refused permission to have it published, because it might have been construed as an attempt at notoriety, not becoming in an officer of his rank, and for that reason distasteful to him. His retirement has removed this impediment, and we are sure that various firms in this country, who have furnished machinery and implements to the Royal Arsenal under his orders, will be pleased to see his portrait, produced from a photograph of 1880.

It remains for us to say that General Altfater, besides his professional attainments, found time to study various economic and social problems involved in the systems of our day, and especially in the Empire that has so profited by his services.

In a recent letter we have had the honor to receive from him, he says: "I yet pursue in a moderate manner the technical studies that have taken up so much of my life," and, no doubt, in this manner he will come nearest to attaining the purpose of his retirement. This brief account is given from personal knowledge of the facts here so compendiously outlined.

CALIFORNIA MINERALOGICAL REPORT, 1891-1892.

The circumstances attending on the preparation of this report will be remembered by our readers. The Governor of the State at the beginning of this year, in his message to the Legislature, recommended that the mass of matter presented as a report of the State Mineralogist be revised, edited and cut down to a reasonable amount of pages, and be confined to subjects correlative with the mining industry of the State. The original copy, and indeed the report as it now stands after emasculation by Mr. Chas. G. Yale, is quite extensive, and this we are compelled to say is its principal feature.

The appointment of Mr. Yale for the work of revision was in every way appropriate. He is a skilled statistician, more conversant with the mining interests of the State than any other citizen that

can be named, and had the special experience of directing the preparation of the mineral statistics of this State for the last U. S. census. With all this he has found an onerous undertaking in dealing with 2,307 pages of manuscript that formed the original matter. The following quotations from Mr. Yale's preface will convey some idea of the work done by him :

"It is to be regretted that in the case of some of the articles, which are recommended to be omitted, the engravings belonging to them have all been made, but these were finished when the report was originally transmitted and there was no thought of cutting down its proportions.

It may be stated that the manuscript shows no signs of having been edited, aside from the mere paging of the leaves and arranging in order. A large amount of material had been left in which had already appeared in the last report or those of previous years. Where two assistants had worked in the same county at different times no attempt had been made to compare their reports and erase one of the duplicated portions. In some instance engravings had been made of the same thing to go in separate chapters written by different assistants, and these engravings are ready for use. The assistants, performing their individual work under general instructions, had written out their observations without knowing the details of the reports of others in the same field.

It is apparent that most of the manuscript had been recopied in the office from the original reports handed in by the authors. Part of this copying was evidently done by persons entirely unfamiliar with mining affairs, and the result was there were many absurd errors. These mistakes could not have been made by the original writers, for many were ridiculous in the extreme. This was not the case in all the copying, but in parts of it, there had been no revision after this copying. * * * * *

"The original manuscript handed to me for revision consisted of 2,307 pages, largely type written. The paging now reaches 1,144, from which must be deducted about 300 pages for erasures in the paged manuscript. None of the entirely erased pages are left in. This will make the report comprise about 844 pages of manuscript. * * * * *

"The report as now submitted to you is almost exclusively confined to mining in the counties of California. Of course many of the engravings and lithographs which have been made will be useless. The engravings prepared for this report have been made at a great expense. There are now printed, ready for use, 10,000 copies of each of the maps and lithographs, yet comparatively few of them will be made use of by the State."

To a stranger into whose hands this volume of 612 pages may fall, it will be a puzzle to understand what it is all about. As a report of the Mining Bureau the first thing looked for would be a

list of the mines in California, their name, location, character and extent, but no such list is given, and no information of this kind is derivable from the report. There are not even the statistics of mineral production, a list of new mines, or indeed any information such as our mercantile and business people desire and require.

We can remember some years ago when the present editor of this report, Mr. Chas. G. Yale, compiled a list of mines in California, as complete as could be made up from the data he could command. This list, imperfect as it was, sold for \$25.00 a copy, a fact we mention to show what the taxpayers of the State have a right to expect for the money voted to the Mining Bureau.

The subject matter that he was called upon to deal with resembles more descriptive articles, prepared for serial publication, than a mineralogical report. It consists of notes made by roaming assistants, who have gone over the State, or to certain parts of it, and noted down what they saw and heard, also prepared extensive and expensive plates and maps that, in the opinion of most people, do not belong in a report of this kind.

In October 1890 there was \$43,812.14 in the Mining Bureau fund, by July, 1891, \$36,183.98 had been expended; from July 1891 to July 1892 the sum of \$30,903.71 was paid out. Of this money \$13,250.00 was paid for technical services as salaries, and the present report is the product, less the printing and engraving, another large sum not charged to the Mining Bureau fund as it should be. Here is a vast sum of \$20,000 or more as good as thrown away when one fourth the amount put into the hands of a man like Mr. Yale would have produced something of value, and relevant to the objects for which the appropriations are made.

This "Bureau" method of performing executive functions has become an incubus on the affairs and resources of this country, and the sooner it is abandoned for responsible and qualified officers the better. A State officer of mines, such as are appointed in the Australian colonies, who would be personally responsible, and would have to present estimates in advance, including printing and engraving, for all public expenditure, would lead to a different result in California.

For ourselves we have no cause to complain, a great share of the matter is in very suitable form for our pages, and may to some extent be drawn upon, but as an expensive public document it is certainly not what people should reasonably expect.

METHODS OF FIRING.

Underfeed stoking, which means that the fuel is fed upward beneath the fire, instead of placed on top, is an extremely common-sense method if considered in the abstract. In the concrete it involves apparatus that is not a desirable adjunct to a steam furnace, also involves artificial or forced draught, but even on those conditions there is strong probability of survival of the system.

There is a conflict of conditions or principles in this matter of heating furnaces that it will be hard to reconcile. If the draught is upward, and the fresh fuel fed on top, the combustion is wrong-end foremost and smoke unavoidable. If downward, the fuel sustaining part, the grates, are burned out; horizontally a draught through a deep stratum of the fuel is impossible.

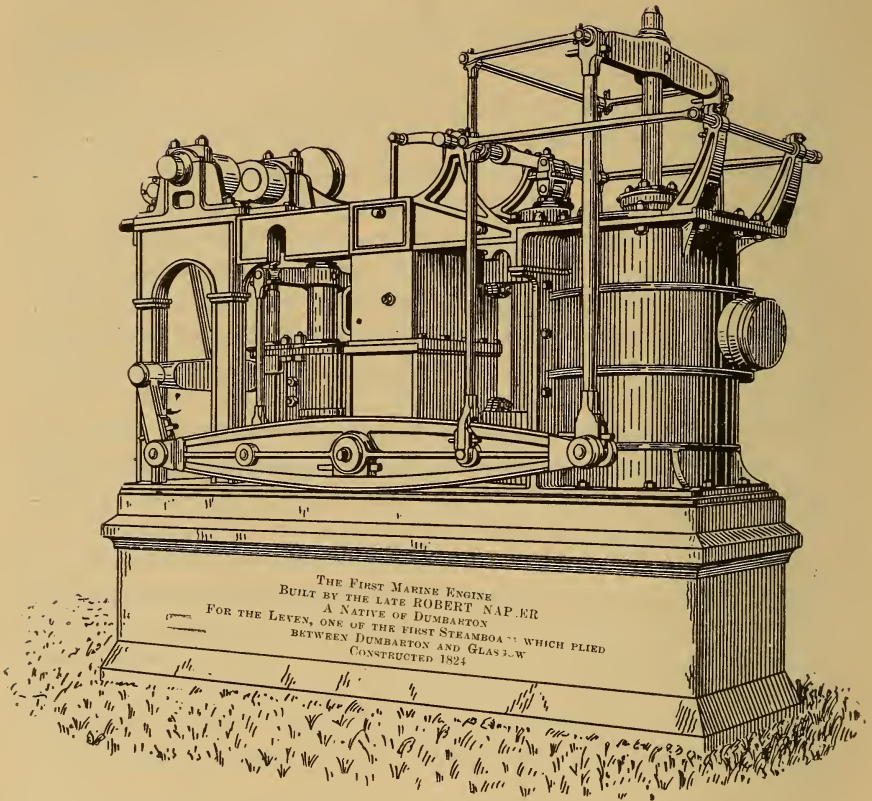
The subject has come with increasing interest during ten years past, and while there has been no distinct invention or method that can be called satisfactory, it is a good deal to have gained the admission that improvement must be made.

Some years ago, when in Portland, Oregon, we came across a steam furnace burning wood for fuel, the supply being forced through a tube under the grates. The impression at the time was, that here was a scheme that might possibly find wide extension in future, and the subject is again brought to mind by a circular received from the Jagoda Furnace Company, of Portland, Oregon, relating to under-feeding furnaces, with tabulated results from various places where their system has been applied.

As now arranged a steam piston is employed to push in at intervals a charge of fresh coal beneath the fire, air being supplied by means of fans.

The Edison Electric Light and Power Co., of this City, have equipped their new boilers with this apparatus for underfiring; so also the Omnibus Cable Railway, and as these large plants are under the care of able and conservative engineers, there is no doubt of the practical working and economy of the system.

It is a fertile field for invention, this fuel burning, and it seems strange to see a struggle after a few per cent. of increased efficiency in steam engines, when ten times as much can be, and is, lost or saved by methods of firing.



MONUMENT TO ROBERT NAPIER, DUMBARTON.

First, and in many respects chief, among those to whom the world is indebted for the development of marine engineering, is Robert Napier. This fact has had recent recognition in the erection at Dumbarton, in Scotland, of a fitting monument to the great engineer, surmounted by one of his first engines, as shown in the engraving above, and described farther on.

Robert Napier was born at Dumbarton, in 1791. His father was a smith, in circumstances that permitted other of his sons to go to college, but Robert chose to remain in the shop. He left home and went to Edinburgh in 1811, and some time later went to Glasgow,

where he worked for a Mr. Lang, who made machinery of various kinds, including callender rolls.

In 1815 Napier's father joined him in Glasgow, and the two started a smith's shop at Gallowgate, in that city. In 1824 to 1826 he constructed his first marine engines, and six years later became interested in a line of packets established by the Glasgow corporation, among which was the *Leven*. In 1834 he built the Dundee and Perth line of steamships, also built several steamers for the East India Company.

In 1840, when Samuel Cunard established the North American Mail Line, Napier constructed the four ships that comprised that line. In 1855 he was awarded a grand gold medal, and the decoration of the Legion of Honor by the French Government. In 1856 he built the *Persia*, and in 1859 turned out his first warship, the *Black Prince*, of 6,100 tons burthen. He next built the warship *Hector*, and followed with all kinds of vessels of war.

His greatest passenger steamer, the *Scotia*, is known to many who will read this. She was the last of the paddle steamers in the New York service, and ran down to about twelve years ago, only during the summer months for the last few years of her career. Not knowing the history of the engine which is erected on his tomb, we applied to Mr. G. W. Dickie, manager of the Union Iron Works, who has kindly sent a photograph, from which the sketch on the opposite page has been made, and the following note in explanation :

"In regard to the Napier monument, I am astonished at the small amount of printed matter in regard to the work of one of the most prominent engineers of this century. This you can give as correct. The old side-lever engine mounted on a pedestal at Dumbarton Pier, on the Clyde, as a monument to Robert Napier, is the first marine engine built by him in 1824, and fitted to the steamer *Leven*, and which worked steadily for fifty years. This form of engine for paddle wheels was Napier's standard type. All the earlier boats of the Cunard Steamship Company were engined by Napier on this plan. Their first boat, the *Britannia*, launched in 1840, was fitted with side-lever engines by him, and their last side-wheel boat, the *Persia*, had side-lever engines, fitted by Napier in 1862. These magnificent engines had two cylinders, each 100 inches diameter, and a stroke of 12 feet, and I doubt if anything in marine engineering has excelled them in beauty of proportion or grace of motion."

THE UNION IRON WORKS.

A reception and ovation was given by the Mechanics' Institute, to the personnel of the Union Iron Works on the evening of the 22d of last month, in the Pavilion. There were addresses and presentations, with music and a large attendance. It was both fitting and deserved.

Among the production of modern engineering art the greatest is a steamship. The Eiffel Tower, the greatest bridges, or any other static work in metal of equal dimensions, cannot be compared. There is ten times the weight to a given length, and the structure a living organism, so to speak, compared with which land structures seem simple and commonplace.

A ship is subjected to circumstances and strains that cannot be computed and are not known. When nearly completed the enormous mass must be moved from the land to the water, and afterwards, for the life of the ship, be subjected at frequent intervals to forces that would at once destroy the strongest structure on land.

Within is crowded a world of machinery, including the most intricate productions of modern science, in steam power, hydraulics, and electricity. It taxes comprehension to grasp the idea of such a creation as a modern war steamer.

The development of this art in an extensive form on this Coast, unaided by any environment such as exists in other parts of the world where it is carried on, is the greatest fact in the industrial history of the Pacific Coast, a fact too great to be understood and appreciated unless set forth by occasions such as the one above referred to.

Such enterprise is not of spontaneous growth; on the contrary, arises out of determined personal effort and risks such as do not take place in ordinary business. It comes from men such as comprise the owners and staff of the Union Iron Works.

The part that such enterprises have in the industrial economy of our times has never been better expressed than by the great Scotch philosopher, Thomas Carlyle, who, more than twenty years ago, wrote: "The true epic of our time is not arms and the man, but tools and the man; an infinitely wider kind of epic."

If space permitted, it would be proper to allude at some length to the discouraging conditions under which this enterprise of the Union Iron Works was undertaken. There was nothing "soft" to

be dealt with except the foundations at the Potrero, 40 to 60 feet of mud. All else was "hard."

A personal conference with the Government cost a journey of three thousand miles. Thousands of letters had to be written, requiring two weeks for answer instead of two days as with the Eastern builders of war vessels; nearly all the material transported by railway across the continent, but, notwithstanding these impediments, the Union Iron Works have conquered a relation with the Government Departments of Construction and Engineering, not attained by any other company or firm, and respecting which but little public knowledge exists. U. S. Naval Constructor Stahl claimed at the reception last month, that the best and most successful work on war vessels has been done here.

In the success of this great work here, the coöperation of the Government officers must not be ignored. The public have reason to know that the staff officers detailed for service here have nearly always been of exceptional ability, and this term includes fair and intelligent coöperation with the contractors.

On a commercial basis, and as a matter of bare statistics, the operations at the Union Iron Works bear out the proposition first made, that it is by far the greatest fact in the industrial history of the Pacific Coast.

A large metal-planing machine, by the Niles Tool Company, exhibited at Chicago, was claimed to be the largest made in this country, which is a mistake. Such machines are commonly rated by their width, and taking the square of the width as an exponent of capacity, a machine in the Charleston Navy Yard, at Boston, is more than twice as large as the one above named, the proportion being as 324 to 144. The weights are relatively as 200 to 150 tons. There is, here in San Francisco, at the Union Iron Works, a planing machine which by capacity is larger than either of these, being 25 feet between housings, but it is not a platen machine and we think none should be at this day when their width exceeds 48 inches. Such machines are very expensive, useless for any but the heaviest work, and unnecessary with modern methods of machine fitting. The Scotch marine engine makers have long ago abandoned such machines for those wherein the tools move over the work, which is fastened on stationary beds or frames.

COST OF COAL IN CALIFORNIA.

Mr. J. W. Harrison, of this City, who has for many years past compiled statistics of the coal and iron trade at this port, has issued two circulars calling attention to the effects that would be produced by a removal of the coal duty, of which nine tenths is paid on this Coast. No one is better able to judge of this matter. The following are extracts from Mr. Harrison's circulars :

"Judging from the inertness of our principal consumers of coal, and the apparent indifference shown by our railroad, steamship and gas companies, foundries and manufacturers, as to whether coal may be placed on the free list or not, an inference will be that fuel is a small figure in their earnings. A principal cause of our foundries, nail and iron makers, etc., running on less than half time, throwing thousands of laborers out of employment, is the high cost of coal. Why should the department select an article like coal and place a tax or duty upon it equivalent to 30 per cent. ad valorem of its original cost? It should have never appeared on the list; protection becomes an absurdity when coupled with coal. Government revenue should be drawn from other sources.

Coal is indispensable, there is no substitute for it here, every individual, and the poorer classes principally, suffer from its increased cost. The extreme rate for gas, foundry castings, and other factory products are all caused by the high cost of coal.

The amount of dutiable coal imported into California last year was 1,108,660 long tons, upon which \$831,495 was collected for duties. This is a weight about the neck of every steam consumer, too heavy to be sustained. Local industries pay fully seventy per cent. of the above tax.

It may be urged that the coal fields of our northern neighbors should be protected, or their collieries will be forced to close. To refute this, the entire output of Washington for 1892 was 1,103,100 tons, of which 719,700 tons were consumed locally in their home market, and they need fear no foreign competition, as their products in no case cost to exceed \$2.00 per ton. Besides, fully fifty per cent. of their exports are from the Carbon Hill Mine, which is controlled by the Southern Pacific Company, who will gladly advocate 'free coal,' thus enabling them to make contracts for such coals as are better suited to their requirements; besides, fully seventy-five per cent. of the coal mined in Washington is lignite, and unsuited for general uses.

California in 1892 produced only 94,540 tons of coal, all of which is an inferior lignite, consumed in the counties contiguous to where it is produced, hence cannot be affected by any change of duty."

"There were over 47,000,000 tons of anthracite coal mined in Pennsylvania in 1892, which was sold at an average price of \$1.92 per

ton at the collieries. Anthracite coal is on the free list and always has been. They likewise mined in Pennsylvania in 1892 over 46,000,000 tons of bituminous coal, which was sold at an average of eighty-four cents per ton, and this is the grade of coal the present tariff protects with a duty of seventy-five cents per ton. This is a burlesque on common intelligence—coal that cost eighty-four cents to profitably produce has seventy-five cents protection, and the \$1.92 coal has none. It may be urged that no foreign anthracite is produced. There are fully fifteen different grades of Swansea anthracite offered for sale here, and we have to-day 41,000 tons of English anthracite loading and en route for this port. Of about one million dollars collected for coal duties last year in the United States, we paid here over eight hundred thousand dollars. Hence the pay rolls of all our factories include about one fourth the number of men they did two years ago, and cut rates are paid to those who are employed.

Connellsville coke is produced from coal mined in Pennsylvania, which is sold at the collieries at an average price of eighty-two cents per ton. The coke can be profitably made there at \$1.25 per ton. Here in San Francisco we pay more duty on coke than the coal costs in Westmoreland County, from which the famous Connellsville coke is made. The average price of coke here for the past five years has been over \$8.00 per ton; in Pennsylvania it is \$1.25 per ton. Our coke imports in 1891 were 40,974 tons, and in 1892 only 21,172 tons, showing the falling off of our manufacturing trades. In the face of such figures, why are we saddled with a twenty per cent. ad valorem duty when the only coke consumed here is of entirely foreign production?

Our imports of foreign wrought scrap iron in 1891 were 21,885 tons; in 1892, 11,113 tons; and up to date (Dec. 14, 1893), 305 tons. Is not this showing particularly distressing? What is the cause of this? A protective duty of \$6.72 per ton. To protect what or whom? It is simply annihilating our rolling mills, nail works and foundries. Why should Alabama pig iron have a protective duty of \$6.72 per ton, when they are making iron equal to, and at no greater cost, than they can to-day in Scotland. The duty is equal to seventy per cent. of the cost of making. This is not rational. Cannot our Government select some avenues through which to draw its revenue other than coal, coke, and iron?"

By the statistics here given it seems that the tariff on coal is a "local issue," as General Hancock called it, one that pertains principally, and indeed almost wholly, to California. This is not the only case of the kind. The duty on scrap iron, on which our whole iron-making industry depends, is another "California tariff."

DOUBLE-ACTING GAS ENGINES.

Messrs. Dick, Kerr & Co., engineers, of Kilmarnock, Scotland, have cut loose, so to speak, from all preconceived ideas respecting gas engines. This firm construct such engines double-acting, compound and triple expanding, indeed in almost any arrangement common to steam engines up to 600 horse power, one of that capacity having been in successful use in a mill at Kilmarnock for some time past.

This engine has two cylinders, double-acting, 21 inches diameter, and one low-pressure cylinder 32 inches diameter, stroke 36 inches. Cards taken from the high-pressure cylinder, only one of which exhausts into the low-pressure one, shows a M. E. P. of 55 pounds per inch, maximum, 144 pounds per inch. The low-pressure cylinder a M. E. P. of 38 pounds per inch, and maximum, 95 pounds per inch.

Another smaller engine of 150 horse power is made with a single cylinder, double-acting, having a piston rod and packing gland the same as a steam engine, which all the different types resemble. The double action, which has been generally pronounced as impossible, is here carried out by a conservative firm, and we suggest that it is time to amend views on this subject.

The principal feature of the engines made by Messrs. Dick, Kerr & Co. seems to be in the avoidance of high pressures and consequent heat, and in maintaining a "good card" throughout the stroke.

The engines are called double-acting Otto engines, and are ignited by a slide the same as the standard Otto engines are. The indicator cards are marvelous for gas engines, especially those from the second or low-pressure cylinder, and would be creditable for a steam engine. The high-pressure cylinders also show a good diagram, except some vagaries produced by explosion at the beginning.

A short time will determine the result of this bold departure in gas-engine practice. The matter will be watched with interest in all countries, and if successful we may look for a much extended use of engines of this kind with increased power and economy.

THE TECHNICAL SOCIETY OF THE PACIFIC COAST.

This Society held their regular meeting at their hall on the first day of December.

The following gentlemen were elected to membership :

H. Clay Kellog, Hydraulic Engineer.....of Anaheim.

Samuel C. Irving,.....of San Francisco.

Two applications were read and referred to the Executive Committee for membership.

Mr. Geo. W. Dickie read a paper entitled "Impressions of a Mechanical Engineer at the World's Columbian Exposition," which was discussed by a number of members.

Dr. Marsden Manson then addressed the Society as follows :

"There seems to be a disposition on this Coast to be indifferent and to tear down anything new in the way of enterprise, or any innovation upon old methods. I do not know exactly why this is, but it is something that needs to be corrected. I believe that in a few weeks there will come in through the Golden Gate the finest built, the fastest, and the best cruiser on the face of the earth. It is the product of enterprise, skill, clear judgment, and high-class work. In view of all this we sit still and leave to the newspapers the task of spreading abroad to the world what has been accomplished, and it goes out as a matter of newspaper puff, there is no solid and substantial recognition of it by our own people. We should grasp the hands of these men who built this ship and congratulate them. Our citizens should call a meeting for the purpose of expressing their approval. We do not take enough interest in these achievements, we allow the matter to pass without paying any particular attention to it. I would like to see this community give the builders of that ship a reception. I am going to bring it before the Mechanics' Institute, and I believe they will take the initial move. I want to see them congratulate not only Mr. Scott and Mr. Dickie, and the leading men of that firm, but I desire to see them express their appreciation to every man and boy that heated rivets, and has been connected with that work. I suggest that in case the Mechanic's Institute takes the initiative, that the Technical Society join with it as far as possible. This Society should be represented ; we ought to be able to say some words of encouragement, and show that we appreciate that work. I move that a committee be

appointed by the Chair, consisting of three members, who will, upon notification, act with any bodies that may be appointed."

Mr. Richards thereupon said :

" I am in sympathy with Mr. Manson's remarks and his views. I ventured the same suggestion in my Journal some time ago. It seems to me that we have been very selfish and very indifferent to allow this great work to go on in our midst without the slightest recognition from our Society. It is a great factor on this Coast. Perhaps our indifference is partly accounted for by the fact that the builders and designers of these ships have not thought it worth while to tell us anything about them. I concur in the fullest manner with Mr. Manson's views, and I second his motion."

The motion was put by the Chair and carried unanimously, whereupon the following committee was appointed for the purpose as embodied in Mr. Manson's remarks : John Richards, Wm. F. C. Hasson and J. H. Striedinger.

Mr. Beaumont, of the Institute of Civil Engineers, England, has invented a device for changing the speed and power between a driving and driven shaft, applicable to electrically-driven locomotives, that has the merit of ingenuity if no more. Internal and external gear wheels are mounted in collars that slide across the face of the car wheel, eccentric to the axle. The internal wheel is driven by the motor, and the external one drives the car wheel at a relative rate, depending on the eccentricity of the wheels, and this is adjustable by means of levers. Theoretically the scheme is perfect, practically we think it cannot be maintained. There has been a long search for differential gearing of the kind, not ended yet, and nearly impossible by mechanism in any form that will withstand the shocks, jars and grit to which such gearing must be exposed. The most practical way of starting a car that has yet appeared seems to be that of Mr. Regan in this City, who maintains a slipping connection between the motor and axle, and can thus apply the momentum of a fly wheel in starting.

GREAT HAMMERS.

The great steam hammer at the Bethlehem Company's works, in Pennsylvania, is at this time the largest one ever made. It is single acting, that is, the falling movement or blow is by gravity alone, steam being employed only to raise the "tup," as the British people call it. The falling weight is 125 tons, and the range 16.5 feet. The whole structure is 90 feet high from the floor, and the foundations extend thirty feet below, so the whole height is 120 feet. The piston rod is of steel, 16 inches in diameter. There are in use two other hammers of 100 tons, one at Creusot, and one at Rive de Gier, France ; and one of 109 tons at Terni, in Italy. The next largest is 80 tons, at St. Chamond, France.

The largest double-acting hammer is at Aboukoff, in Russia, rated at 50 tons, but this rating will not do to compare with gravity hammers. The blows may equal in force 100 tons falling only. The great hammer at Bethlehem is outdone by a hydraulic forging press recently erected there, that exerts a pressure of 14,000 tons. The force is not accumulated, but is direct by steam pistons acting on the water with a force estimated as equal to 16,000 horse power.

If the effect produced by these vast engines could be accomplished irrespective of speed or velocity there would be no need of such great weight, but an element of time enters into these forging processes, necessary because of inertia in large masses to be reduced, and also because some time must be allowed for the heated metal to flow when under pressure. This is more nearly attained by a heavy weight falling slowly.

The increase of hammers to the enormous proportions named is to acquire this time required, the principle culminating in the forging presses, more commonly employed all over the world for heavy work, especially in England, where hydraulic apparatus has attained the greatest development. The presses acting slowly permits the metal to move uniformly throughout, or "to the center," as it is called, while a quick blow acts only on the surface.

A familiar example of this is in the use of hand hammers, which, as all know, must have weight in proportion to the object struck, independent of the dynamic energy of the blows. Pile driving is another illustration. A light ram splinters the piles without moving them.

LITERATURE.

A Problem in Patent Law.

BY JOHN H. MILLER, SAN FRANCISCO.

This is an essay on "double use," or the application of known contrivances or agents to new uses or purposes, and treats upon a subject that is at this time a principal one in patent law procedure.

The author, who is well known here as a prominent counsel in patent litigation, has presented for legal guidance not only the principal decisions bearing upon this problem of double use, but has added copious comments that render the matter quite clear, and we can commend the work especially to those seeking legal interpretation of how far a new application can constitute an "invention."

The term "double use," it seems to us, is not relevant and misleading. The issue is between similar and dissimilar use of mechanical agents or processes, and the difficulty of determination rests in understanding and defining what is analogous in such different uses.

An engineer or mechanic can at once determine in his own mind how far the faculty called invention enters into a new use of familiar expedients, but it is not easy to put such conception into words, which must be done to meet the requirements of the law. In a decision of Chief Justice Cockburn, in England, which Mr. Miller quotes, there are the following words:

"Although the authorities establish the proposition that the same means, apparatus, or mechanical contrivance cannot be applied to the same purpose, or to purposes so nearly *cognate and similar*, as that the application of it in the one case naturally leads to application of it when required in some other, still the question in every case is one of degree, whether the amount of affinity or similarity which exists between the two purposes is such that they are substantially the same, and that determines whether the invention is sufficiently meritorious to be deserving of a patent."

As a matter of fact, the determining element in all such cases is the "result." A new result includes new use. In evidence of this is one of Judge Blatchford's decisions,

involving the sand blast invented by Gen. B. C., and R. A. Tilghman, of Philadelphia, an excerpt from the decision is quoted by Mr. Miller, as follows:

"Grave reference is made on the question of novelty to patents granted for projecting a stream of sand combined with a jet of steam from a locomotive engine, for the purpose of driving cows from the track of the railroad; and a learned expert, who makes an affidavit on the subject, says with great truth, that the only difference between such use in combination of a jet of steam and a stream of sand, and the use by the plaintiff of the combination of a jet of steam with a stream of sand, is that in the former case the sand, after having had velocity imparted to it, came in contact with cows, while in the latter case, it comes in contact with glass, stone, etc. This is the only difference, but in this difference lies the distinction between the two. No one from observing the temporary operation of the process on the animal would infer that he could, by the same means, produce the results which the plaintiff describes. Nor is there any semblance in kind between those results and the result produced upon the animal."

Perhaps the principal point here is the expert evidence referred to. This seems to us especially ridiculous, in view of an intimate acquaintance with the origin and rise of the sand blast processes, described in Number 1 of this Journal for August, 1888.

The subject here treated is continually present in preparing patent specifications, indeed the character and nature of the claims in patent specifications have been wholly changed in ten years past to meet this problem of new use and new results, and Mr. Miller's essay is as timely as it is able.

Engineers' Field Books.

The A. Lietz Company, of this city, have prepared field books for engineers, containing on the first pages a series of tables for stadia reduction for every two minutes of vertical arc from 0 to 30 degrees, giving the corrected horizontal distances and differences in elevation to the formulæ $K a \cos.^2 n$, and $K a \frac{1}{2} \sin. 2 n$, respectively. The books are bound in leather, of good paper, and pocket size. Price, singly, 75 cents.

Report of the Chief of the Bureau of Steam Engineering.

NAVY DEPARTMENT, WASHINGTON, D. C., 1893.

Commodore G. W. Melville presents his report for 1893 in succinct form, containing the usual tables and data respecting work in process and completed during the year. As this matter forms the subject of concurrent comment throughout the year by the press in all parts of the country, there is no need of its reproduction here.

At the end of the statistical portion of the report Commodore Melville, in his usual terse style, reverts to the paring down process applied to boilers for naval service, and with pardonable pride alludes to his own course contrasted with the policy of the Admiralty in Great Britain. His remarks are as follows:

"It may not be out of place to recall the fact that when, a few years ago, foreign governments were reducing the weight of machinery in their ships, a favorite method, and the one which effected the greatest reduction, was to reduce the size of the boiler, making the gases from the several furnaces (as many as eight in large double-ended boilers) debouch into a common combustion chamber, and by using very strong forced draft get an indicated horse power on trial which so weakened the boilers, and produced so much leakage around the tubes, as to make the boilers almost worthless before beginning service. This type of boiler is one which this Bureau has constantly opposed as being unfit for naval vessels and unsuited to the purposes of forced draft. The type adopted by the Bureau is one which long experience had shown to be efficient and capable of withstanding hard usage, and it is a source of great satisfaction to know that in the trials of our new ships the boilers have stood the strain admirably, and that in service they have proved highly satisfactory. To such an extent had the former design been carried in England, with attendant leakage and unreliability of the boilers, that it was deemed necessary to appoint a committee of engineers to "consider existing types and designs of propelling machinery and boilers," and to make suggestions for their improvement.

The report of this committee, recently published, recommends a type of boiler almost identical with that which this Bureau has been designing. The committee likewise recommends certain apparatus connected with the feeding and the circulation of water in the boilers which has always been required in our machinery specifications. I deem this statement of the trials of our foreign brethren justified, in view of the statements which were so loudly expressed at one time, that our machinery was too

heavy, that we were putting 30 per cent. more weight in our boilers than were the English, and similar statements calculated to discredit the work of this bureau. In the light of the sad experience which that type of boiler has had, it looks as if we had put the weight where it was most needed, for we have not been compelled to resort to any makeshifts, however ingenious they may be, to carry our ships through their trials."

In the section under the head of "Personnel," Commodore Melville returns again to the subject of engineer rank in the Navy. From this we publish excerpts under another head.

International Irrigation Congress.

LOS ANGELES, CAL., OCTOBER, 1893.

PROCEEDINGS.

This report, consisting of 160 pages of double column brevier, contains an amount of matter that precludes careful perusal.

A general inference is that amidst an epoch of universal research in the physical world the disposition and control of water for irrigating purposes, a vast human interest, has been much neglected.

The problem divides itself into different phases, involving the ownership, conservation and distribution of water for irrigation. To these and other features, including many interesting facts, there were contributed a large number of addresses and papers that betoken a learned and careful consideration of the subject. Delegates from foreign countries participated in the proceedings. Mexico, Australia, Russia, Peru and South Africa were represented in the meeting.

The most remarkable address was that of Major I. W. Powell, of the U. S. Geological Survey, who claimed that over a greater part of what is known as the arid regions of the United States the water available for irrigating purposes is insufficient to serve the lands already sold and held by private owners. Major Powell, in both writing and speaking, has the misfortune of an involved style in ideas or words, or both, that makes it difficult to follow him or to understand just what is meant, but it is futile to dispute the proposition that lands cannot be irrigated when the total rainfall is not one fourth of what is required by the land. This is true of much of the arid country. In other places there is an excess, in proportion, but there is no way to equalize the water, and each district must be confined to its own natural

rainfall. The truth, no doubt, lies between the statements of Major Powell and the less pretentious views of practical men.

The problem of irrigation presents itself under one leading issue, laws to govern the distribution of water and the distinctions between public and private rights. Irrigation is now a private interest like any other industry or enterprise, and any participation of the General Government must take the form of concessions to private interests.

No act of the Government is just unless it have reference to the public. Navigable streams are open to public use, and thus their maintenance properly becomes a charge of the General Government, and it is to be hoped that no schemes will be brought forward to confound natural and private interests in this great enterprise of watering arid lands.

Continuous Current Dynamos and Motors.

BY F. P. COX, B.S.

The W. I. Johnson Co., Times Building, New York, issued the above treatise, in which an absolute system of measurement is a salient feature, and in which the reader will be particularly impressed with the correlation, or even identity, of the generating power and its electrical resultant.

The work is intended especially for students, and is comprehensive in that degree which modern methods of study permit.

At this day a "work on electricity" would mean either an elementary one, or a collection of generalizations without much practical value, hence the scheme in the present case is correct, and indeed, imperative, if the subject is to be intelligently considered.

The chapters on motive power constitute the best essay we have seen on the subject of indicator diagrams, which are distorted to show the most common faults of valve arrangement and other abnormal working conditions of steam engines. We think, indeed, that the publishers would do well to issue Chapters XIII and XIV in separate form, for the use of plain steam engineers, who have not the time or opportunity of studying extensive treatises on this subject. No intangible element like electricity can ever become popularly understood. It must always remain a mystery to the public, beyond its visible phenomena. The present treatise goes as far as possible, not in ele-

mentary explanation, but in resolving the quantities, relations and nature of electric currents and their generation. We can heartily commend the work. Price \$2.00.

Standard Tables for Electric Wiremen.

BY C. M. DAVIS—FOURTH EDITION.

This little book, published by the W. J. Johnston Co., New York, is one among a number that contain instructions for wiring, but is so far as we have seen, one of the most complete and practical, as its fourth issue proves.

The book is pocket size, leather covered, and is a true working "implement," filling a place where, of all others, such reference is required. The diagrams are striking, being drawn in perspective where that renders the connections more plain, and by the variation in lines and other respects, indicates an ingenuity on the part of the draughtsman and his practical acquaintance with the art. A number of the most important tables were prepared expressly for this work, and, being copyrighted, cannot be found elsewhere. Among these are the tables of alternating current wiring coefficients, those on limiting currents for exterior wiring and on the candle power of arc lamps and the table, enabling the wires for the three standard lamp voltages to be used for any voltage or drop, as well as several others, including a complete set of wiring tables calculated on a uniform basis of 55-watt lamps. The price of the book is one dollar.

Wrought Iron and Steel in Construction.

A book of tables, formulæ and examples of iron and steel sections, with other products of the Pencoyd Iron Works, Philadelphia, Pa.

This little book is an example of the care and expense that large manufacturing firms of the present time give to what may in one sense be called trade circulars, and in another sense, useful books of reference. In the present case there is an unusual amount of useful matter. Indeed, the whole book is a most useful reference for engineers, contractors and iron merchants. It is an eighth edition, containing about 300 pages, and can be procured from Messrs. A. P. Roberts & Co., Philadelphia, Pa.

LOCAL NOTES.

The North Pacific Coast Railway, that comes in at Sausalito, on the Marin County Peninsula, has begun improving its terminal and ferry facilities, and under a new board of managers is preparing to utilize opportunities that have long been neglected. The Marin Peninsula is an ideal suburb of San Francisco, and it has been owing to accidental circumstances that this romantic region has not long ago become the home of thousands of our citizens. The mountain, six miles distant, 2,700 feet high, and most of the intervening lands are picturesque, watered and warm, sheltered from the ocean by hills 700 feet high. The shores are "windward," and with the deep water attracted the yachting interest many years ago. The Fulton Iron Works have under construction a new ferry boat for the company. New slips are being built, the line is being improved, and another year will, no doubt, take an exodus of people in that direction.

The Edison Electric Light and Power Company, of this City, ranks among the principal ones in the country. There are 8,500 horse power employed in generating. The new station on Jessie Street is a marvel of completeness with every requirement and convenience. The switch board is of marble, 57 feet long and 9 feet high. The Company have absorbed the California Electric Light Company, the Edison and General Company interests, also the Fort Wayne, Excelsior and Schuyler rights, and is in control of nearly the whole lighting and power business of this City. The recent enterprise of introducing salt water for condensing to the higher and main station will make an important saving in fuel, and an increased output of current. The executive officers have grown up with this vast business and its intricacies, and with one half the usual administrative force have conducted all in a most successful manner.

Mr. Lubin, of Sacramento, Cal., in a pamphlet we have received, proposes a scheme of transportation by the Government at an uniform rate irrespective of distance, as a measure to protect our farming interests against an inequality of conditions at home and competition abroad. We cannot spare time to study the subject, even

when presented in this compendious form, but can easily see that the consequences of such a system would be revolution in land values. It would equalize these to a great extent. The author does not seem to have drawn any inferences from the Swiss methods of transportation, where, as we are informed, one sends a letter, a steam boiler, or a ton of coal all in the same manner. We would be glad to see a farmers' "issue" of some kind in this country, something they could unite upon and force some recognition of their equal rights under a fair economic system, but such a scheme is too broad and deep for popular understanding, or for farmers' understanding, so long as they will deliberately vote to saddle their industry with unequal taxes.

In a letter recently received from Mr. L. C. Russell, of this City, a gentleman well known by many of our readers, now residing in Philadelphia, and in no way connected with ship building, we learn that people from San Francisco are not admitted to the Cramp Ship-Building Works at Philadelphia. The following is an extract from his letter :

"I recently went out to Cramp's with the intention of visiting their establishment. In filling out my application for a pass I very foolishly stated that I resided in San Francisco (one is obliged to state their residence). As soon as Mr. Cramp saw it he said : 'Oh ! we cannot let him in.' It was amusing as well as provoking."

If visitors are admitted to these works we do not know of anyone more deserving of such courtesy than Mr. Russell, who is incapable of visiting anywhere with an improper motive, and we think if there is a rule, such as this circumstance indicates, it would be well to publish it, so as to save the trouble and disappointment to people from this City in asking for admittance.

The reclamation work on Grand Island, in the Sacramento River, under the direction of J. W. Ferris, C. E., of this City, is progressing at a rapid rate. We recently examined at his office here, photographs of the new dredging machinery at work, and also tabulated results from the works that are astonishing. The effect, stated in general terms, is two cubic yards per minute, raised and conveyed 150 feet. Mr. Ferris has for many years past made a study of land reclamation here, starting with the advantage of a wide experience in Europe, and in methods and machinery has

attained the greatest success. His works on the San Joaquin River and the Novato lands in Marin County, are well known, and now he has in hand greater problems in the Sacramento Valley, including Grand Island. The large pumping plant, described elsewhere in notes, is to form a part of the extensive plant on these Grand Island.

An advertisement in this number of *INDUSTRY*, relates to a novelty in technical instruction, the "Correspondence School of Mechanics," at Scranton, Pa., a system by which lessons or answers to questions are given by mail. The scheme may at first seem chimerical, but when one reflects that a question formulated in writing is apt to be one of import, and a personal answer given in writing and filed is likely to be remembered, the method may after all be as practicable as it is unique. The suggestion no doubt arose out of the many "answers to correspondents," that one finds in the industrial literature of the day, and there will be the advantages, as in that case, of having carefully considered and correct answers to problems and questions. We have sent for further information and may have in future something more to say of the system.

The *Oregon*, that was launched on the 26th of October by the Union Iron Works, is a "battle-ship," or as called in former days, a "man-of-war." There are three vessels of this size, the other two, the *Massachusetts* and *Indiana*, are being built at the Cramp works, in Philadelphia. These vessels were ordered in 1890, and are to cost four million dollars each, exclusive of guns and other armament, which, with speed premiums, now quite evident, will bring the whole cost of the three ships to at least \$14,000,000. The *Oregon* is 348 feet long, 69.25 feet wide and draws 24 feet of water. The displacement is 10,000 tons, and a computed speed of 15 to 16 knots an hour. The armor on her sides is 7½ feet deep, four feet of this being below the water line. The armor belt is 18 inches thick. Above this the sides are covered with plates 5 inches thick. The turrets are 17 inches thick, but, being tapered, the horizontal thickness is about 20 inches. The armament includes four 13-inch rifle guns, 20 six-pound rapid firing guns, and a whole arsenal of smaller weapons. The engines are double, with triple cylinders 34.5-in., 48-in. and 75-in. diameter, 42 inches stroke. These are some of the principal dimensions of the wonderful creation at the Potrero.

The City of Guadalajara, in Jalisco, on the Rio Grande, in Mexico, has been fitted out with an electric lighting plant of 1,650 horse power, driven by turbines, and an electric plant from the Thomson-Houston International Co. The power is derived from falls in the Rio Grande. This sounds a little as though there was some waste in our complaints of a want of enterprise in Mexico. The works have been erected by a banker in the City of Mexico, to whom the water power belonged. Less than 100 miles from San Francisco the Clear Lake Basin discharges through Cache Creek to the Sacramento River in a descent of 1,200 feet, water that represents power to light this city and Sacramento twice over. It is true, 100 miles of transmission is a formidable impediment, or at least an expensive one, but is not impossible.

We examined, last month, a centrifugal reclamation pumping engine at the works of Mr. Byron Jackson, in this City, that has, so far as we know, the largest capacity of any that has been made on this Coast, or elsewhere in this country. The pump has pipes 44 inches in diameter, and will raise 30,000 gallons per minute. The engines are directly connected or, as we should say, the pump, engines, air pump and condenser are one machine, all parts being integral. The machine is compound, with cylinders $13\frac{1}{2}$ and 25 inches in diameter, about four to one. The steam distribution is performed by a single valve recently patented by Mr. Jackson. The pump was constructed to the order of Messrs. Ferris & Williams, of this City, and is intended for reclamation work on Grand Island in the Sacramento River, in Reclamation District No. 3. We will not attempt to go over the details of the machine, but will say that in general design, quality of the castings, and the fitting, this huge engine is a great credit to the makers and to the skilled industry of this Coast.

The trial of a naval vessel is a vast scientific process, involving almost everything; triangulation, photography, dynamics, kinematics and the rest, and is very expensive. The first trials of the *Olympia* footed up a sum of \$30,000 for the contractors, and being indeterminate, this sum can be written off to experience. The results, like astronomical computations, require a long time to make up, or rather take a long time to make up on the part of the Government officers, but the methods of the contractor are more rapid. We obtained a "surreptitious" glance over the tables and footings of

Mr. W. R. Eckart, consulting engineer to the Union Iron Works, after the return of the *Olympia* on her first trials. This work is of the most elaborate kind, involving diagrams, tables, and all kinds of "quantities," was "completed on board" before the return of the vessel. How it could be done in the time is a mystery. The work includes complete graphs of the ship's movements, and tables, rate, coast profile and stations, with a log of all circumstances worthy of note. The coast at Santa Barbara seems admirably suited for trial runs, which are gauged from monuments on the shore. The phenomenal result of the *Olympia's* final trial trip does not need repetition.

COMMENTS.

The German Government in order to provide guns, munitions of war, and maintain their army, need more revenue than even the present drastic system there produces, and propose to tax wine to produce an increase of 10,000,000 marks (\$2,380,000). This has set up a vigorous opposition, and naturally. The farming interests have in Germany suffered severely under the present system, and the chances are that no farther encroachments in this direction will be permitted. German foreign trade under the stimulus of a high tariff on home prices has reached and passed its zenith, and a reaction is now in order. What this craze to raise money for war purposes is to end in is not a comfortable reflection. A possible result is the murder of hundreds of thousands of people, and the destruction of untold millions of wealth to be replaced by toil and suffering.

The Carnegie-Steel Company continue to import their tools from England. The last is a heavy hydraulic press, by the Whitworth Company, at Manchester, England, the parts of which are sent over in different consignments, and are no doubt imported as unmanufactured iron. One piece received recently weighs 64 tons, and the whole press when completed will weigh 1,500 tons. Why such machines are not bought here no one can understand. The immensity of the castings is certainly not an impediment. There are firms in Philadelphia that could cast and fit up a hydraulic press of any size, quite as well as the Whitworth Company, but not at the same price if the duty is evaded. Mr. Carnegie's idea of tariff is that it should pertain to what he "sells," and not to what he "buys."

Three more parties or expeditions, British, Norwegian and American, have started out on a search for the North Pole. A hundred men or so are to be again subjected to the tortures and probable death that awaits them in a latitude where there is nothing whatever to be desired, and no important end to attain, that need concern the people of any country. It is a national "fad," to use a slang term, resting more on morbid curiosity than anything else, and should be suppressed, except as to the leaders and organizers of these expeditions, who should be dispatched to the Pole as soon as they have contracted the infection. The next thing will be search expeditions to find the explorers, and then another crusade like the present one, until some restraint is placed upon the enlistment of men for such a purpose. The scientific ends in view can well be ignored in the interests of humanity.

The *Forum*, principal among our essay monthlies, has been reduced from 50 cents to 25 cents a number, and from \$5.00 to \$2.50 a year. The *Cosmopolitan*, a high-class magazine, was some time ago reduced from 25 to 12½ cents a number, and the yearly rate accordingly. There is a wide meaning in these circumstances. The advertisers instead of the readers are paying the bills, and education is being taxed on commerce. Does this mean progress or the reverse? The reverse, we think, because it is a degradation of the intellectual agencies of our time if they cannot be made self-supporting. The revenues of governments have been made a burden on industry and commerce; accumulated wealth and profits escape their fair proportion of public taxation, and now it seems that literature and learning are to be loaded upon trade. We may soon expect gratuitous copies of Shakespeare with decorated "insets" that proclaim the merits of "Pears' soap."

Consul J. C. Monaghan, at Chemnitz, Germany, writes a communication that will be a surprise to most people in this country, by showing that our cotton packing is bad and a great hinderance to trade. A bale of cotton from India weighing 400 pounds contains 10 cubic feet, and one from this country weighing 475 pounds contains 22 cubic feet, showing that the Indian cotton is compressed to about one half the size. This nearly doubles the freight, which is by the cubic yard. Egyptian cotton is compressed still more

than the Indian. A bale of 700 pounds contains only 15 cubic feet, or to compare by the weight per foot the comparison is as follows : Egyptian, 46.6 ; Indian, 40 pounds ; American, 21.5 pounds. The closer the cotton is packed the more safely it can be transported, and the risk of fire is less. The covering material is also reduced, and we much wonder at this matter if the statements apply to common practice in this country.

We have received an order to prepare engravings on wood for a number of machines from a firm that has experimented for some time with what are called process plates. It is also noticed that some of the illustrated magazines have returned to wood engravings, so once more, and for a score of times, this process comes again to the front, after being "superseded." There is but one fault with wood engraving. It is expensive, as all bold-relief work must be, and for that reason is not available or possible except for permanent uses. For popular and descriptive literature wood engraving is certainly gone, unless it be when the extent of impressions demand electrotypes, but in the case of engravings of machinery to be employed in letter press work and in duplicate, the wisest, and in the end the cheapest, way is to have good engravings made on wood.

The *Railway Age* and *Locomotive Engineer* contain photographic illustrations of how the local trains on the Illinois Central Railway were operated at Chicago during the Fair, and how trains were loaded and unloaded with passengers in from 10 to 15 seconds. It is wonderful, no doubt, to as many as have never seen a railway provided with platforms and side doors in the carriages. To those, however, who have seen railways in Europe there is nothing novel in the matter. It is simply the English system of traffic just as it exists everywhere in Great Britain and on the Continent. What could have been done with the traffic at Chicago with cars having a door at each end and a flight of steps to climb in order to reach these doors, or, to state it another way, what could be done with an American train in London or any of the densely-populated districts of the old country? Stops on the Metropolitan Railway, in London, do not average 20 seconds, in which time hundreds of people are loaded and unloaded. Why do not the editors of the papers above named explain this matter?

The higher-class serials came last month with copious commentaries on the effects that will follow the Great Exposition, especially on the city of Chicago. We must admit with others that this city of trade, where everyone had something to sell or was looking for something to purchase, has done a wonderful work and deserves credit therefore. We have made it a custom for twenty years past in frequent journeying to and through the Northwest to get through or past Chicago in the most rapid way possible, but now imagine that some change will occur in the spirit and purposes of that great trading community, if its municipal government can be maintained with even its past probity. Among the articles written on the influences of the World's Fair, Mrs. Palmer's, we think, is the best, and is thoroughly good. The diction is commendable even in the *Forum*, where the article appears.

German manufacturers and machine makers have organized a combination for the purpose of equipping and sending agents into the South and Central American countries to solicit trade. These men will be furnished with Spanish lists and catalogues, and speak the language of the countries visited. There is a similar organization for Africa, and dictionaries of the principal African languages have been prepared in Germany. The various agencies of one kind or another to promote trade are the most thorough the world has ever seen. This is done with the impediment of dear material, and a tariff in Germany, but a "drawback" on exported goods, which works much injustice to the consumers at home, but one cannot help admiring the tenacity of the German people against a sinking foreign trade and a tariff handicap.

The daily newspapers are the best exponent of a people's civilization. One may enter as a stranger into any large city in the world peopled by the Caucasian race, and learn all about habits, tastes and general state of being, from a single issue of a popular newspaper printed in the place. Credulity and superstition are there shown by the advertisements of fortune tellers, soothsayers and quack doctors, also by the nature of trade advertisements that appeal to sentiments and weaknesses of the people. In the news columns appear a record of disorder and criminality, and in the editorial sections is reflected the capability of popular understanding, in short the newspaper is a reflex of the conditions that exist, and

is generally "what the people want," in fact a popular and successful journal must deal with "general averages." Any department taken alone is almost sufficient to declare the character of a community, but the whole taken together is, as before said a faithful exponent.

When a private citizen can build a steamship 330 feet long, of the most expensive character, for amusement, it is time that something was done in respect to a progressive income tax. We are speaking of the *Valliant*, owned by Mr. W. K. Vanderbilt. Vast aggregations of wealth in the hands of venal men may become a menace to Government and Society, indeed is so in the hands of many men, setting them off, except a coterie of retainers, from any direct communication with the people. Their money is generally spent in a selfish manner, and one may say a stupid manner, when fame is the object, as it usually is. Mr. Vanderbilt and some other rich people in this country have money enough to construct the Nicaragua Canal, or other great work of that kind, which, conducted under honest personal management would not cost one half what such work would in the common routine, and would leave a monument the whole world would honor.

ENGINEERING NOTES.

The handling or lifting and conveying of earth, silt, and so on, by machinery is, in this country, making rapid progress, especially in what is called suction dredging. The machinery this far is cheap and not so complete as it will be some time, but this is no fault of the makers. The art is new, and those who employ such machines must be educated up to the point of high-class work. In "movements" the Americans seem ahead, and for grading, ditching, dredging and the like we lack now only good construction. The Germans are quite proficient, as was proved by their machines employed on the Manchester Canal. At Panama, American machinery performed most of the work done. This set the English engineers at work, and they have carried out most of the German and American ideas in more substantial and economical mechanism, which we must sooner or later follow, especially in what may be called "dumping dredges" for harbors.

Mr. Ambrose Webster, of the Waltham Watch Company, the principal one in this country and in the world, in a recent paper on the subject of the watch-making industry, gave some very interesting facts. There have been in the United States thirty-six attempts to found watch making, of which seventeen survive, less than one half. These works have a capital of \$10,000,000, employ 12,000 people, and produce 7,500 movements for watches a day. There are 5,000 women employed, whose wages average \$1.50 per day. The 7,000 men receive twice as much, or \$3.00 a day. The manufacture of cases is a different industry altogether. In 1890 there were 47 factories of watch cases, producing 6,000 a day, and having a capital of \$5,000,000. The number of people employed is set down at 5,000, and the average wages \$1.66 per diem. In 1850 the product was only five movements a day. The evolution of this manufacture affords many useful lessons, especially in its later phases, including the Waterbury watches. It has required 40 years, and the time is not long, considering the result.

Mr. T. E. Edison, the famous electrician, is sometimes credited with droll remarks and bad grammar, but there is usually in his sayings a deal of truth and common sense. If he had five years ago told people respecting aluminium, "there is nothing in it," as he is credited with saying, he might have saved newspaper editors from their assinine proposals to construct ships, railways, trains, bridges, and what not, of this white metal. About the only use of aluminium we have seen that appealed to mechanical fitness, was for engineers' instruments, and even this was an alloy. "It is cheaper now than brass," Mr. Edison says, and this is true, because its volume compared to brass for a given weight is about as 26 to 8.5. With aluminium at 50 cents a pound, brass should be less than 16 cents a pound to match, which it is not, for machine parts at least. It has caused a fearful waste of ink and adjectives, but not in this Journal as our files will prove.

The Memphis Bridge over the Mississippi River at that city will be a remarkable structure when completed, and one of the most difficult examples of engineering work ever undertaken. Mr. Geo. S. Morison, chief engineer of the work, has presented a paper on the subject to the Institution of Civil Engineers, describing the process of placing two of the piers in swift-running water from 36 to 48 feet

deep, and sinking them 40 feet through the silt and loose material to a stratum of clay, on which the work rests. The spans are, two of them 651 feet, and one 790 feet. The two central piers will be 200 feet high from the foundation, and even with the top of the bluff at Memphis. The work is all on a colossal scale. The caissons were of timber 97 feet long, 47 feet wide, one $59\frac{1}{2}$ feet high or deep, the other $39\frac{1}{2}$ feet. The cost of the two piers completed, the main ones, is \$600,000. The strangest part of all was protecting the bottom of the river from scour by means of immense willow mattresses, 240 feet wide and 400 feet long. These were sunk first, and the caissons cut through the mattresses after sinking.

It has always been a matter of amazement to us to find with British engine lathes, of one kind or another, a "stack" of change wheels, more than double the number that is required in this country. There is there a system of screw threads, followed as we believe, as generally, if not more so, than in any other country, but a screw-cutting lathe requires or is provided with 22 change wheels. It is true these wheels do not cost much, being cast in most cases, and good enough when well cast, but their number indicates some fault of arrangement. The trains are commonly double, that is the screw gearing is compounded, and that is very undesirable, also is unnecessary if there is a proper arrangement of spindle connections. We suspect the first lathes were made with twenty-two extra wheels, and the time for change has not yet come. It is like operating the feeding gearing of planing machines from tappets on the tables. The idea of feeding by other means has not yet reached the British machine-tool makers.

The subject of ball bearings for machinery has been a prominent topic for some time past in technical journals, especially in England, and in connection, to some extent, the twin idea of roller bearings. One writer now sums up opinions and facts very nearly in conformity with views given at various times in this Journal, namely: That such bearings, whether fitted with balls or rollers, are unsuitable beyond light pressure, and unnecessary, unless it be to gain a small percentage in "muscular" machinery. This view is strengthened by the fact that successful use of these experiments is mainly confined to bicycles and grindstones.

In various exchanges we see notices of machine belts and bands made of paper, and there is certainly nothing impossible in making a machine band of such material. There is nothing about machinery that receives more care than bands. Their requirements are flexibility, strength, a degree of elasticity and adhesive surfaces. These qualities are all found in paper. The required strength will be the matter of most doubt, but if any one will glue up, or cement by some proper material, sheets of any kind of strong paper, such, for example, as the Japanese and Chinese make, until the thickness of a leather band is attained, the strength will far exceed leather. Any kind of strong paper that will pile 1,000 to the inch, if cemented together with India rubber, should make a first-class machine band, and the wonder is that such bands have not sooner been made.

A high authority in Europe has recently said the idea of automatic expansion engines has become a "perfect fad in the United States, and has much hindered the development of compound engines there," also claims that the Willans engine, made by the M. C. Bullock Co., of Chicago, is not approached in economy by any automatic expansion engine. This we believe is a pretty strong statement of what is after all a possible truth. Steam engineering is universal, and to attain a correct view of progress one must study the trend of practice in all countries. By this rule it does seem that the automatic idea has "been overdone" in this country. It has, however, brought about a wonderful amount of constructive improvements, especially in valves and their gearing and regulating apparatus. We have always contended that regulation by cut-off, and varying expansion in proportion to resistance or load, is "logically inconsistent," and requires to be compensated by countervailing advantages to become admissible in good practice.

The great Ferris wheel at Chicago was made under circumstances that may be called "how to do it." It took three years and 2,500 sheets of drawings to produce the Eiffel tower at Paris, and a staff that, no doubt, cost one fifth as much as the tower itself. The Niagara suspension bridge, which is one fourth the weight of the wheel, required three years to construct, while the latter was made in five months. The technical work we are quite sure did not cost one tenth as much as that of the Eiffel tower. The parts were all

fitted and prepared at the works for erection, and then sent to Chicago, where everything went together "like a clock." The wheel is 250 feet in diameter, and its foundations are 35 feet deep in the earth. The strains in a static structure are much easier to compute, there is a racking action set up by revolution that reverses many of the strains continually, and tends to loosen riveting and joints. There is too, the wind stress, an important and almost unknown factor to deal with. The feat was a remarkable one.

We notice in some recent designs for mill engines the eccentrics are placed on a small shaft, well forward and near the cylinders, and this shaft geared by bevel wheels to the main or crank shaft. There seems to be reasons to recommend this. The eccentrics, which require a good deal of care, are made accessible and are clear of the crank and fly wheel. They can also be made one half as large as would be required if they were on the main shaft. It is not unusual, as we know, to employ a separate and small shaft for engine eccentrics, but they have usually been near the main shaft and inaccessible when the engine was in motion. A long motion-rod, with a vibrating motion, sets up resilient action and is more objectionable than a rotary shaft, and usually requires bracing when long, so there are good constructive reasons for the arrangement above mentioned.

The Babcox & Wilcox Boiler Co. refused to accept an award, or enter into competition for one, at Chicago, on the grounds that such awards are not based upon actual experiments and intelligent investigation, but mainly, we think, because a refusal to compete is a better advertisement than a prize would be. This is not disparaging the company, but the awards; still the boiler company well knows that a practical test would have been extremely difficult to conduct. Some time ago a friend came in and inquired for some one to conduct a boiler test. We introduced him to a competent mechanical engineer, who, on learning the errand, shook his head and said: "Have not enough men, instruments, or time. It will cost you five hundred dollars, and be vague at that. People are not yet educated up to boiler tests," continued he, "and I would rather do anything else, submarine diving included; besides, I have a reputation to maintain." We were a little astonished just then, but less since, when the matter is thought over.

A Canadian inventor blows air, preferably heated air, under the grates of steam furnaces by means of steam jets, and claims to gain thereby a marked economy over natural or common forced draught. The apparatus consists of a plain air pipe, with a series of small induction nozzles, to draw in and propel the air, and is so simple and inexpensive that it is well worth a trial. The function of the water or condensed steam may have something to do with the result. Almost any new thing to save fuel is worthy of consideration at this day. Mr. S. R. Earle, at Belleville, Ontario, Canada, makes the required multiple nozzle, and will no doubt furnish information respecting them. Long before the period of water gas and the chemical knowledge that now exists in respect to combustion, there was a belief in the economy of steam jets discharged into the gases of combustion beyond the fires. Western steamboats, forty years ago, were fitted up with steam jets or blowers in the after-ends of the flues and beyond these jets the flames were bright and clear.

An inventor and manufacturing company at the East have discovered that a projecting "scoop" four or five feet long, armed with rollers, cushions and a flexible bulkhead to land against, will without injury pick up and stow people who are caught in front of street railway cars. There is no doubt of it, and if the companies who operate such cars can be forced to provide the tackle no one could be successfully run over, but there remains the wider problem of the right of any one to drive a vehicle among people at a dangerous rate. The use of public streets for private interests is a problem of our age, and in this country has its most serious aspect. The need of rapid conveyance is a necessity, and its existence among the foot traffic of our streets is mainly because of the "free franchise" and the immunity from damages for personal injuries that is counted upon under our laws. What is to be done is not clear, but apparatus to "scoop up" pedestrians who get in the way is certainly not a solution of the problem.

M. Bazin, a French engineer, proposes to construct a steamship on rollers, and foreign journals say one is actually to be made. There are to be eight buoyant rollers on which the vessel rests, the propulsion being performed by screws in the usual manner. When this vessel is completed it would be interesting to witness a race

between it and one of the log rafts constructed in Humboldt Bay. The chances would be about even. An account says "the computations carefully made show," etc. This whole idea of water rollers is absurd. There is no rolling action without adhesion, and no gain except a partial avoidance of skin friction. The difference between pushing these rollers through the water when still or revolving will not be much. Such schemes grow out of what may be called "unskilled analogy." They are landsman's ideas of walking or rolling on water.

The strangest bit of literature met with for some time is that of an editorial in *Locomotive Engineering*, complaining of ornamentation on foreign-made locomotives and eulogizing the plainness of the American exhibits at Chicago. Ten years ago the distinctive feature of American locomotives was burnished surfaces and gaudy colors, and there is no mechanic, engineer, or other sensible person, who will not agree that present plainness is a most desirable thing, indicating an advance in the art. Let us hope the same remark can be made at some early day respecting other machines. The carved red, white and blue decoration of machines detracts a great deal from their estimated merit, and is "provincial," or "backwoods," as we call it. Such finish as a machine requires is some bright metal surfaces, and these do no good flanked by gaudy paint. Any paint that reflects or glistens "kills" all finished work, prevents photography, and is bad in all views. In fact the quality of machine work is generally indicated by the amount of decoration.

ELECTRICITY.

NOTES.

Professor George Forbes, an English electrician, has been placed in charge of schemes for electrical transmission from the Niagara water power plant. He has recently had to deal with an electrical transmission problem of great extent in India, where the Government had cut a long tunnel from one valley to another lower one for irrigating purposes, developing by water wheels 50,000 horse power. It is proposed to utilize this power by means of wires to Madras, 350 miles distant. That such things are being "con-

sidered" and done, indicates the possibilities of electric transmission, and supposing a fruition of such plans, the effect economically will call for vast changes or accretions to our present industrial interests. Professor Forbes, in a recent paper, has outlined his plans for Niagara, which are conservative, qualified in every way by circumstances that indicate the current can be successfully carried to New York. There is power much nearer there, however, on the upper Hudson River for example, and at the falls of the Mohawk River, near Albany.

However advanced electrical engineers can claim their art to be there is certainly a good deal to be determined yet, as Professor Forbes' late paper on the Niagara transmission will show. The frequency of alternation or pulsations, as a mechanical engineer would say, is the main point, and when generators of 5,000 horse power, such as the Westinghouse Company are now constructing, have to be considered, the importance of this feature can be imagined. The fact is that in nine tenths, if not ninety-nine hundredths, of the apparatus made, the limits of cost enter largely into designs, but in this case are almost absent, and hence will arise controversy because of different views. We reserve the right of thinking that no other water power plant of the same kind as the present one, will be erected at Niagara with vertical shaft transmission, and that the plans laid out here and approved by Mr. Ferranti are better.

The new process of heating by an electrical current in a pail of water, announced at first as a German invention, is now ascribed to Messrs. Lagrange & Hoho, of Brussels, Belgium. A vessel is partially filled with acidulated water; in the water is a lead plate as wide as the vessel and twice as long the other way. This plate is connected to a one pole generator of about 110 volts, 150 amperes. The metal to be heated is connected by a similar wire to the other pole of the generator, and is immersed in the water, upon which the piece is at once heated up to even a melting temperature. This sounds miraculous, and if no impediments appear in useful application in the arts, it is one of the most important electrical discoveries yet made. There must be an "if" somewhere in the case, because if such intense heat can be instantly produced with a current such as is named, a thousand uses stand waiting. It sounds a little like the accumulator announcements of ten years ago.

The Washburn & Moen Company some time ago erected a special factory and plant for large conducting wires, and have found these extra facilities necessary. The Company have just completed the feeding wires for the great Brooklyn City Railway Company, that employ 8,000 horse power at one station. The wires reach 210 miles, and amount to the enormous weight of 1,000 tons, and cost \$300,000. These feeding wires are insulated, and the processes of manufacture are intricate and extensive. The Washburn and Moen Company had furnished the insulated wires for the Brooklyn lines previous to the present extension, and with such success as to command the present order, which is perhaps the largest ever given. The railway company was fortunate in contracting for their conductors when copper was at its lowest price. A rise is now probable.

MINING.

NOTES.

In the Cripple Creek gold mining district, in Colorado, where there are about eighty gold mines, there is being produced from \$150,000 to \$200,000 a month. The *Engineering and Mining Journal* says the ore is of low grade but plentiful in this district, and also points out a marked increase in all of the gold mining interests of Colorado, and we think the same remarks will apply soon to the silver and other industries of this enterprising State. Especially when they have a Governor who is not likely to inaugurate a war against the United States and create "seas of blood." Colorado has been fortunate in the class of people who have settled the State. It was nearer to the older regions than the trans-mountain States and has always attracted solid business men.

Hydraulic mining has been resumed at various mines in this State, with corresponding gain in employment and trade around the mines. Every one wishes well of this and all other industries that can be carried on without interfering with the rights of other people, and now that there is an authority to be appealed to, and a special Act of Congress to define the conditions of operating, there is much less danger of abuse than when the General Code was set aside for special laws. The "millions to the State," of which we have heard so much, will not be gained. The returns of the mines will go to

their owners and not "to the State," but there will be substantial gain in proportion to the accretion to our productive industry, the same as there is from other pursuits.

ARRASTRAS IN CALIFORNIA.

It is not commonly known that arrastras are in regular use at some of the California mines. The last report of the State Mining Bureau contains the following account of arrastras in Nevada County, employed for disintegrating gravel:

"The arrastras are 12 feet in diameter and 3 feet deep. The bottoms are paved with hard rock roughly dressed, and in such manner as to present as even service as possible, and laid in cement, the paving being 16 inches in depth. The post in the center is 14 inches square and 18 inches high, carrying the mast with four arms, to each of which a heavy drag is attached. The motive power is transmitted either by means of a large horizontal pulley, through whose center the mast passes and upon which a belt runs, or by means of a toothed gear fixed in a circle around the nearest and into which a pinion works. This last is the preferable arrangement. The drags are heavy blocks of diabase hung to the arms by means of chains and clamps, and so arranged that all portions of the pit are traversed by them when they are rotated. They weigh from 600 to 1,200 pounds. To charge the arrastra, gravel is either run in from a car, or, better, from a chute; 5 to 9 tons constitute a charge. While the charge is being introduced the speed is lowered, water being added from time to time in order to prevent the charge from caking. A large quantity of water is taken up, and the charge finally has the consistency of thin paste. The arrastra is speeded up to fourteen revolutions a minute; in case of hard cement this is kept up one hour. It is discharged by opening a gate in the arrastra, which empties directly into the sluice containing the riffles. The charge runs itself out, water being added to facilitate the discharge. By a judicious mixture of "sharp" or crushed gravel and the ordinary gravel that has gone through the grizzly and has not required crushing, it is remarkable what a thorough grinding and pulping the gravel receives from the process. About one tablespoonful of quicksilver is added to each charge, the loss in quicksilver falling below 10 per cent. The sluice run is nearly 200 feet long, the boxes containing for the most part the ordinary longitudinal riffles. The sets nearest the arrastra, however, have the cross riffles, and likewise the last sets in the run. The sluices are cleaned up once a week. Almost the whole of the amalgam will be found in the first cross riffles near the arrastra, very little getting further down the sluice. When running off the charge about 30 inches of water is required. Drags last six weeks and cost about \$5 apiece. A new bottom costs \$40, and last about six months. The capacity of one arrastra on hard cement is 50 tons per day; on soft "top gravel," 75 to 90 tons per day."

MISCELLANEOUS NOTES.

The Topolobampo Colony, in Mexico, seems in a way to succeed after passing through two or more "sieges." It is a socialistic and coöperative society, on the plan of the Kaweah Colony, but with a larger amount of honesty in its founders and managers. The property is in 100,000 shares of ten dollars each, and of these 15,000 have been sold. At the end of 1892 there were 500 people in the colony, and a large accession, principally from England, is now going on. The secret of success, if success it will be, is, no doubt, in the democratic form of government. At first all things were regulated by a set code; now all rules are voted upon or made by the people, subject only to some cardinal principles that may be called a constitution. If the Topolobampo experiment fails the coöperative idea may, as well be abandoned, for this Coast at least.

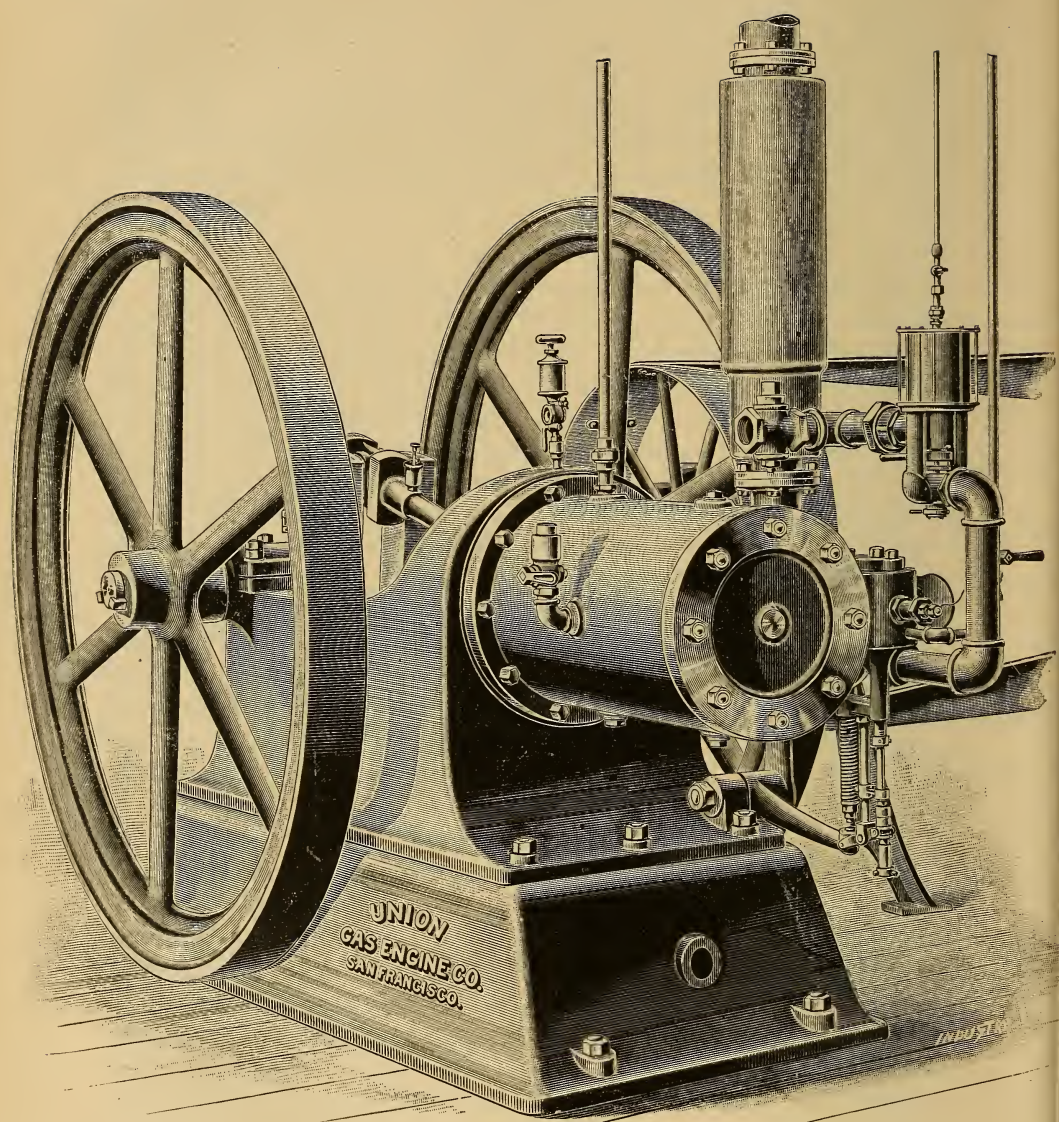
The great dam on the Colorado River, at Austin, Texas, now completed, is one of the greatest works of the kind in this country. It is 1,150 feet long, 68 feet high, faced on both sides with granite; the interior work is limestone, all laid in concrete. The water is taken out from the dam in eight penstocks of iron, 9 feet in diameter, to deliver 14,500 horse power for 10 hours daily. Water wheels for pumping a city supply, also for electric light and power, have been contracted for, and are being erected. The cost of the dam was \$608,000, and the work as a whole must have a great deal of influence on the future of Austin, concentrating there such industries as require motive power. The whole work undertaken, including water wheels, pumps and distribution, will cost \$1,400,000.

Some one in this day of great steamers has bethought themselves of the *City of Rome*, almost as large as the largest of the present time, constructed about ten years ago, and the most symmetrical vessel in the whole trans-Atlantic fleet. The *City of Rome* was built by the Barrow Company, in England, for the Inman Line, but because of a hitch in their affairs could not be paid for, and became the property of the Anchor Line, of Glasgow, in which we believe the Barrow Company are interested. She is of 8,415 tons register,

560 feet long, 52 feet beam, has engines of 10,000 horse power, and steams quite fast enough to earn money. She is almost without shear, her deck lines nearly straight, which, with an overhanging stern, gives her in every respect, except size, the appearance of a fine yacht. In fact there never has been a yacht built that has finer lines than the *City of Rome*, so that all things compared, the late monster steamers are not so much of an advance, as people commonly suppose.

In this country there has been a good deal of experiment, and, as we believe, a good deal of success in making steel balls by hot processes, such as pressing and rolling. In England, on the contrary, the manufacture has been conducted on the cold treatment plan, the balls being cut out, so to speak, from sections of rods or bars, and finished afterwards by abrasive processes. At a factory in Coventry, England, 80,000 such balls are produced daily, of the finest steel, tempered, gauged to one thousandth of an inch and polished. The balls are employed in the bearings of bicycle wheels, and other cases where the pressure is light and lubrication objectionable. The Auto-Machinery Company, above mentioned, employ a large number of automatic machines that turn out the balls within three one thousandths of an inch for accuracy, and up to two inches in diameter, most of them are however quite small. The price is from half a cent a piece for balls one eighth inch in diameter, to fifteen cents a piece for balls one inch diameter.

Messrs. Pedrick & Ayer, of Philadelphia, makers of high-class machine tools, by reason of extensive additions just previous to the present trade depression, were compelled to suspend payment and turn the works over to a receiver. It is seldom that a firm engaged in making machinery fails in Philadelphia. Such business there is usually on a sound foundation, and there is a spirit of co-operation such as is wanting in most other cities. There is also better credit with banks and other sources of capital. We are glad to hear the business is resumed and is to continue. The firm confine their attention mainly to railway tools and appliances, also are makers of what is known as Richards' side planing machines for metal, and stand very high among machine tool makers in this country.



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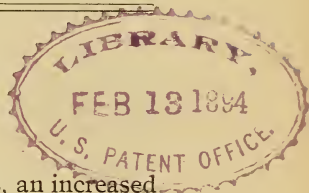
FEBRUARY, 1894.

No. 67



TANGENTIAL WATER WHEELS.*

J. RICHARDS, IN CASSIER'S MAGAZINE.



There has arisen in this country, during recent years, an increased interest in, and a more extended use of, that class of water wheels that bear the names of "tangential," "impulse" and "partial turbines;" also sometimes called "open" or "free" turbines from the fact that the wheels are not enclosed, or submitted to pressure.

The name turbine, derived from *Tourbillon* or "boiling," does not in respect to relevancy apply to the tangential or impulse class of water wheels, but usage of it comes from the analogy in construction and application of impulse wheels, to pressure, or real turbine wheels. There is a clear line of division between the two, however, and present indications are that those operating by impulse are about to supplant, in many cases, the pressure types, especially when there is considerable water pressure, or for heads exceeding twenty-five feet. Reasons for this conjecture exist in the greater simplicity, reduced cost, and also higher efficiency, which is, or ought to be, attained with tangential wheels.

It is hard to account for the earlier and more complete development of pressure-turbine wheels, unless upon the supposition that scientific attention was especially directed to them from the beginning, and their somewhat intricate nature and complete adaptation

as "first movers," created an interest such as always attaches to the new and mysterious. Scientific analysis has not, however, in forty years past, led to much uniformity of practice in constructing such water wheels.

They are divided into types or classes varying greatly in construction and manner in which the water passes through them, but conforming in all cases to the distinct principle involved, which is the complete, or nearly complete, retardation of flow, so the "pressure" of the water is converted to turning moments, and then escapes in a state of rest.

This, the writer is aware, is not an expression conforming to mathematical analysis of turbine action, or to the commonly entertained opinion that the work of a turbine is a resultant of impact, reaction and pressure, but this does not matter; the premises to be derived from pressure-turbine action are not important in considering the impulse class of wheels so long as the spouting force of water is conceded as equaling its gravity less the friction in discharge orifices, and the losses of reactive discharge at divergent angles. It is on this latter law of spouting force or impulse, and without the least complication, that the principle of action in tangential wheels rests.

The impulse method of applying water as a source of motive power is unquestionably the oldest as well as the most simple, but in all early applications there was a neglect of what we may call the residual forces. Impingement took place on flat radial faces at various degrees of obliquity to these faces, and there was no provision for deflection, or release of the water, which spent a considerable part of its energy parallel to the axis of the wheel, or parallel to the faces of the vanes, at the same time clogging or retarding them.

In this country the earliest understanding of impulsive action, as distinguished from pressure in turbine water wheels, seems to have been arrived at by Mr. Jearum Atkins, whose wheel is one of much interest, because, as the writer believes, anticipating the Girard or partial turbine form in Europe, at least in so far as main principle is concerned.

Mr. R. D. O. Smith, of Mishawaka, Ind., who is well acquainted with Mr. Atkins and his discovery of the correct method of applying water to wheels on the impulse method, in a letter to this magazine says:

"Atkins' wheel was patented in 1875. The patent has now expired, and I am at liberty to say that the wheel was invented, built, tested and an application for a patent was made more than twenty-

five years before that date. That application was rejected, just as this one was, because the examiner did not comprehend it. Atkins, then poor, had associated with him a capitalist friend who insisted upon abandoning the matter when it was rejected. All this may be ascertained from the records of the Patent Office Rejected Applications. Thirty years afterward he sought to recover something of this lost invention, and the patent above named is the result.

Engineers will be interested in the record of this early invention, and therefore the specification filed in the Patent Office, February 27, 1853, is freely quoted.

'The nature of my invention,' reads the specification, 'consists in so forming and arranging the various parts of the wheel and trunk that the water acts continually on all the buckets, approaching the wheel (as near as may be) in the direction of a tangent to its circumference. The water flows in smooth, unbroken sheets, acting by its centrifugal force against the semi-circular faces of the buckets, until it reaches their inner points next the shaft, when, having spent its force upon the wheel, it drops down through its open bottom and escapes underneath.'

After describing the mechanical structure, Mr. Atkins says :

'The important points to be observed in the construction of this wheel and appendages, are : First, that the gearing used to communicate motion from the wheel to the machinery which it is designed to operate should be so arranged as to allow the wheel's velocity at the axis of the buckets to be equal to one half the velocity of the water at the point of impact, or where it issues from the mouths formed by the guides as described ; second, that the aggregate width of all the channels or water passages between the buckets of the wheel, which may consist of a greater or less number according the size of the wheel or the amount of water which it is designed to use, should be equal or nearly so to double the aggregate of the mouths or water channels formed by the overlapping of the guides.

As it is impossible in this specification to give the details of mathematical calculations by which I arrived at the results obtained by the before described arrangement, I will only state some of the facts by which the maximum motion of the wheel, namely, one half that of the water, is predicated, and also show the absolute necessity, in order to obtain the full power of the water, of the form of the buckets, and also their peculiar adaptation to the water trunk, as herein-before described in relation to the motion of the wheel. As the power of water, as of other bodies in motion, is measured by its velocity, or, in other words, as velocity is power, it is obvious that in order that the moving water (or other body) may communicate its whole power to another moving body, the velocity of the former must be swallowed up in the latter. The object is effected by the before-described mode of applying water to a wheel in the following manner, the velocity of the wheel, as before stated, being one half that of the water. Let us suppose the velocity of the water to be

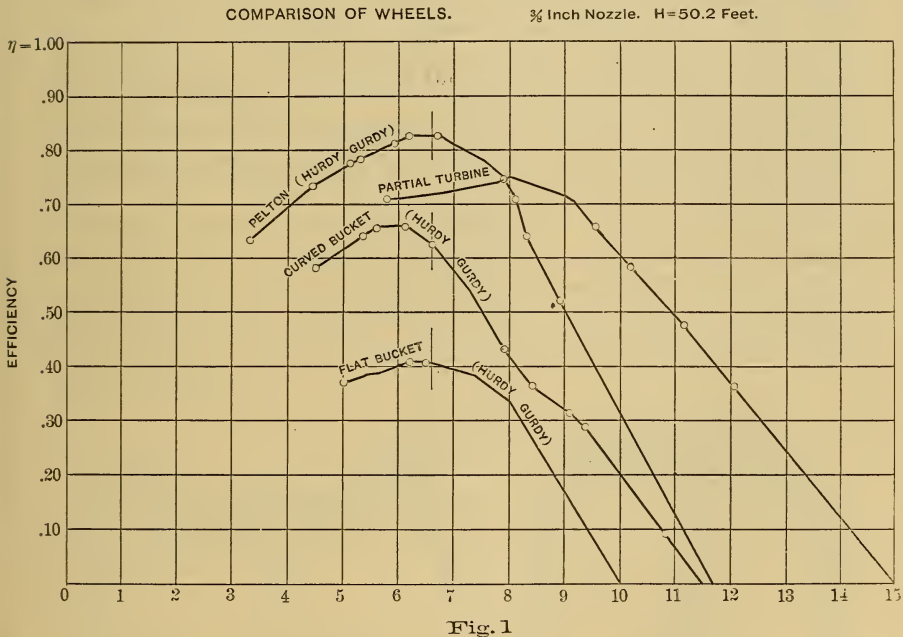
twenty-four feet per second; then the velocity of the wheel being twelve feet per second, the relative velocity of the water with respect to the wheel, or the velocity with which it overtakes the wheel, will be twelve feet per second. Now it is proved theoretically, and also demonstrated by experiment, that water will flow over the entire surface of the semi-circular buckets of the wheel with the same velocity with which it first impinged against them, or twelve feet per second. Then, as the water in passing over the face of the buckets has described a semi-circle, and as its return motion on leaving the wheel is in an opposite direction from that of the wheel, its velocity with respect to the wheel being twelve feet per second, and as the wheel has an absolute velocity of twelve feet per second, it is obvious that the absolute velocity of the water with respect to a fixed point is entirely suspended at the moment of leaving the inner point of the buckets, its whole velocity, and consequently its whole power, having been transmitted to the wheel. If now we suppose the velocity of the wheel to be more than twelve feet per second, say sixteen feet per second, we shall find, by a calculation similar to the above, that the water will leave the wheel with a velocity of eight feet per second in the same direction of the wheel. On the other hand if we suppose the velocity of the wheel to be less than twelve feet per second, we shall find that the water on leaving the wheel has a velocity in the direction opposite to the motion of the wheel, the measure of which will be double the difference between the velocity of the wheel and twelve feet per second. It is thus proved that when the wheel moves faster or slower than one half the velocity of the water there will remain in the water, after leaving the wheel, a certain degree of velocity, and consequently of power, which has not been communicated to the wheel, and is therefore lost, thus proving the maximum motion of the wheel, as above stated, to be one half that of the water.

I have stated above that the measure of the sections of all the water passages between the buckets of the wheel should be equal to double the measure of the sections of all the throats through which the water issues in its passage from the trunk to the wheel. The reason for this is obvious when we consider that all the water which issues from the trunk in a given time must pass through the wheel in the same time, and that the capacity of the channels through which a given quantity of water passes in a given time must be in inverse ratio to the velocity of the water.'''

Mr. Atkins, more than forty years ago, had arrived at a point in this branch of engineering investigation that not very many of the present day have reached, and much honor is due him for his researches, which if followed out at the time might have added millions of wealth in this country, and saved us from the humiliation of having to go abroad to find suitable designs for water wheels to be employed at Niagara Falls, and for which none of our makers,

save one, received any recognition by the Commission appointed to examine plans for these wheels.

The exception was the Pelton Water Wheel Company, of San Francisco, who are makers of impulse or tangential wheels that have been evolved from the necessities of use in the mountain districts of California, where pressure turbines were almost impossible. The plans submitted by this company were not commenced until nearly the end of the time allotted, were hastily made, and might now be greatly improved. They have been substantially adopted by M. Ferranti for the projected works on the Canadian side at Niagara.



Tangential wheels are quite simple in all respects but one, the form and position of the vanes or buckets. These have been tentatively developed on the Pacific Coast by the cut and try method, but there has besides been a good deal of mathematical treatment in the way of analyzing vanes in use, and perhaps no better example could be named of how powerless computation is to take the initiative and develop new things of the kind, unless supplemented by constructive skill and observations in practice.

In 1883 the University of California entered upon some experiments with tangential wheels, conducted mainly under the direction

of Mr. Ross E. Browne, in Professor Hesse's department of mechanical engineering. The bulletin published in that year by the College of Mechanics, except the fundamental principles laid down by Weisbach and others, has remained almost the only literature of these tangential wheels, and is now perhaps out of print.

Partial turbines as they are called, were prepared in imitation of the Jonval and Fourneyron wheels, the vanes being carefully made to conform to the theoretical curves of these wheels. Why the Girard type, which is the true impulse wheel of Europe, was not included, we do not know, but the result was that the highest efficiency was attained with the Pelton wheels such as were then employed for great heads in the mines of California. Other tests made at the University of California were of a laboratory nature, but conducted with great care, and no doubt indicate as nearly as possible the true efficiencies of the types of wheels represented. The results are shown in the diagram Fig. 1, which has been re-engraved from the original.

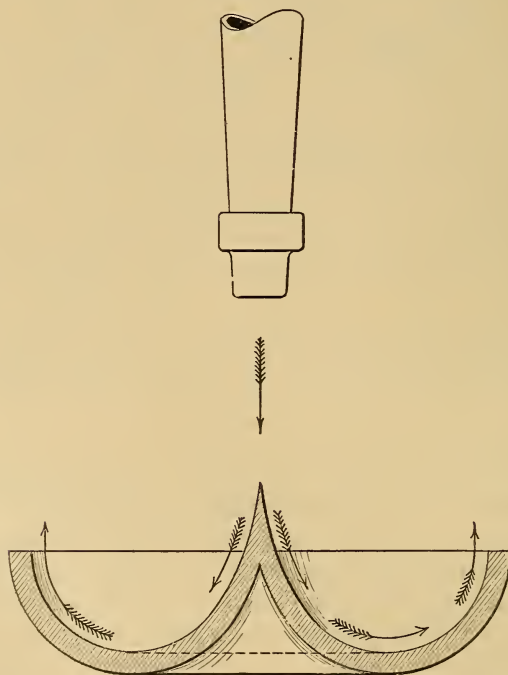


Fig. 2

Tangential water wheels, unlike pressure turbines, involve no intricate problems extending to all the parts involved. As before

said, the whole problem of efficiency is narrowed down to the form of the buckets or vanes and some other conditions of minor importance, such as the form or section of the jet, which is commonly cylindrical because of that section presenting the least frictional surface in proportion to volume.

There have been various forms of these buckets prepared and tried on the Pacific Coast, hundreds it might be said, and the results noted as carefully as possible at mills and flumes, by means of brakes and measurement of the water consumed.

These buckets, except the first crude forms, which were only flat planes or teeth like a saw, have nearly all conformed to the principle of receiving the stream on a sharp apex that divides it, the sides terminating in curves that reverse its course. The object sought, or the ideal bucket, would be represented in the diagram, Fig. 2, in which the receiving or opposing surfaces will be a cylindrical dish-shaped vessel, terminating in a sharp cone, the surfaces or dimensions of the whole being as small as possible to avoid flowing friction.* We need not say that such a bucket is impossible when set in revolution upon a wheel, also is incapable of succession in a stream.

The kind of bucket most extensively employed on the Pacific Coast is the Pelton form shown in Fig. 3, consisting of two shallow cups separated by an acute dividing wedge, the angles on all sides being divergent.

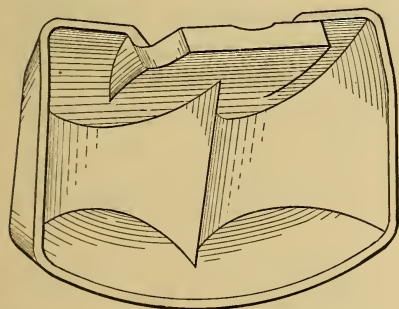


Fig. 3

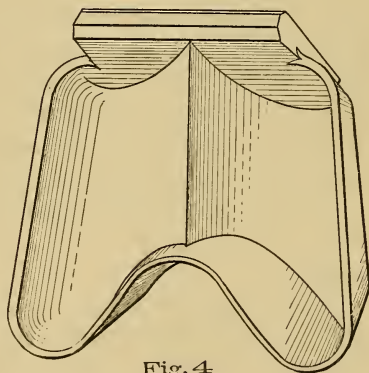


Fig. 4

Fig. 4 shows the Dodd, or as it is called "sigmoidal" bucket, that has for two years past been applied with very good results.

Fig. 5 shows the Knight buckets, the invention of Mr. Samuel N. Knight, of Sutter Creek, California, and extensively employed

* The curves here have been altered by the engraver from the original drawing.

in mines and elsewhere with success. This form of bucket, or the wheels of Mr. Knight, form quite a study in hydraulics. The stream applied is of an elongated or oval section in the plane of the wheel's rotation, and the chute or nozzle fits closely around the periphery of the buckets so there is a question as to whether these wheels do not in some degree, perhaps in a considerable degree, act upon the principle of pressure or partial turbines.

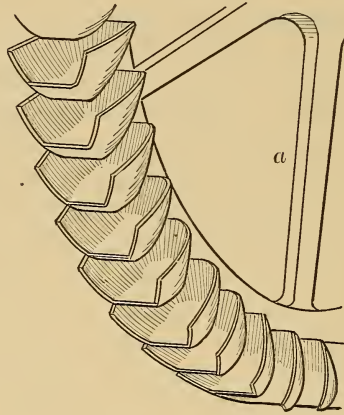


Fig. 5

Mr. Knight gains an important advantage over plain jet wheels in the large amount of water which he can apply on the wheels with a single nozzle or chute, and thus can adapt his wheels to low falls. He has quite a large works at Sutter Creek, and extensive facilities for experimenting with hydraulic apparatus, and is, so far as the writer knows, the only successful maker of direct-acting hydraulic engines of large power for operating mine pumps.

In Europe, as before mentioned, the Girard, or partial turbine wheel constitutes the only class operating by impulse or partially by impulse.

These wheels, which in a less perfect form date from about 1855, are now constructed with much uniformity in nearly all the countries of Europe, where mill gearing is made, and the theory of their action is perfectly understood.

Fig 6 shows the curves and form of vanes and chutes taken from the drawings of Messrs. Günther & Co., Oldham, England. The right-hand view is a vertical section, and the left-hand view a radial cross section through a part of the wheel and the entrance chutes. These chutes *dd* are made in numbers sufficient to dis-

charge the maximum amount of water required, and are uncovered by a circular sliding gate on top moved by a tooth pinion.

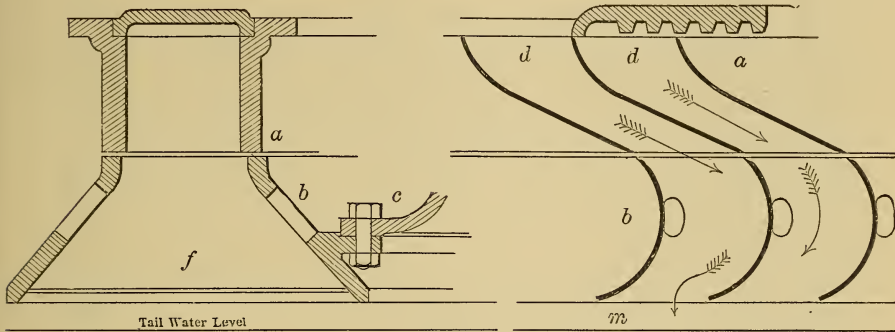


FIG. 6. GIRARD TURBINE.

The part *a* contains the chutes, and *b* is the revolving portion or wheel, supported on a disc or set of spokes *c*. The wheels are flared at the bottom, as seen at *f*, to permit a more free escape of the water, and holes are provided at the sides for the escape of air, and to support the cores in casting the wheels.

Mechanically, and in respect to construction, these wheels are a refinement in hydraulic practice, and are made with great accuracy and completeness of design, due to emulation and a wide experience by many able firms. The name "partial turbine" is relevant and describes the Girard type of wheels, because they are really turbines, having only a few instead of a complete set of chutes or inlets, with, however, the farther difference that the passages through the wheel are greater in area than the chutes, the same as in the Atkins wheel, before noticed. This permits an impinging action; the wheels being open or unfilled are not under pressure of the head, as in real turbines.

Reverting again to the buckets shown in Figures 3 and 4, or indeed, to all buckets of this class that have been invented, it is obvious that when revolving on a wheel, the conditions under which they operate are varying at all points of their passage through the stream. The angles and curves are constantly changing. If the surfaces of impingement are right at one point, they must be wrong at all other points while subjected to the stream. The resultant angles, with respect to the axis of the jet or stream, are continually changing, and the wonder is that the energy of the water thus applied should give out so high a degree of efficiency. On the other

hand, if the water could be applied under uniform conditions as the buckets pass through the stream, there is no reason why an impulse wheel should not, as before remarked, give out ninety-five per cent. or so of the energy imparted by the water.

It will therefore seem that a series of buckets rigidly attached to the rim of a wheel must, as the wheel revolves, of necessity change continually their position in relation to the stream, and that there is no possibility of uniform conditions during the period of the water's impingement, but this is not quite correct. A recent invention in these buckets really attains very nearly an uniformity of conditions, or of curves and angles during the whole of the working range of the buckets. It was an examination of this new form of buckets that led to the preparation of the present article, and the new features involved will now be explained.

The invention referred to is that of S. Lucien Berry, of Philadelphia, set forth in his patent No. 493,239, dated March 14th, 1893.

The main figure of the drawings of this patent is reproduced on a smaller scale in Fig. 7, and is clear without much explanation. The line y of the stream or jet, meets the buckets at $m m m$, radial or normal to their convex faces presented to the stream.

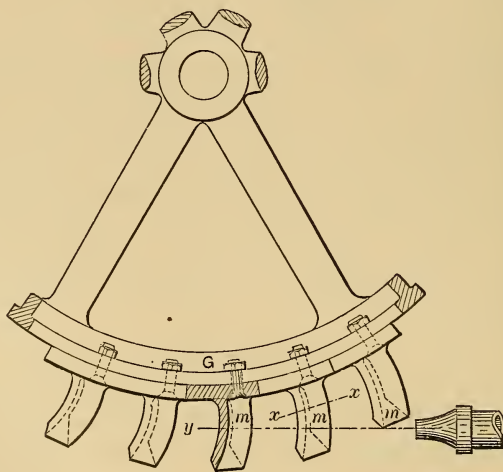


Fig. 7

In the preamble of the specification of the above-named patent, it is stated that the invention —

“Consists in forming the buckets with a double curved bottom, presenting a sharp dividing apex in the center to split the stream or

streams of water discharged on the wheel, and also curving the buckets in the opposite plane so they will present a convex surface, normal to the stream of water, in all positions of the buckets being acted upon.

My invention also consists in forming the buckets open as to their outer ends, and reducing the edges thereof to a thin knife-like section, so there will be no disturbance of the stream discharged on the wheel, by the buckets when entering it.

In this class of water wheels, having buckets of a double curve and a dividing apex in the center to split the stream of water, it has been the custom to either curve the buckets both ways, so as to present a concave surface to the water, both transverse to and in the plane of rotation, or else to form them with straight lines on their bottom in the plane of movement. In my invention the object is to present in the plane of rotation, surfaces normal to, or at a right angle with, the impinging jet or jets of water, permit its free discharge tangential to the wheel, and avoid disturbance of the stream by the entering buckets. This object I attain in the fullest possible manner by presenting a convex instead of concave surfaces to impinging water in the plane of rotation, preserving the contour of a double curve in the other plane, transverse to the course of the impinging water. I also dispense with what may be called the outer inclosing end of such buckets, leaving them open in the form of a trough, and beveling the entering plates to an edge so as to avoid disturbance of the stream as the buckets enter and sever it."

The claims of the patent are as follows :

"1. In a water wheel driven by impinging jets, a series of buckets attached to the rim, double curved in their transverse section and also curved in the plane of rotation, as herein described, so as to present, in that plane, a convex face, normal to the impinging water, when the buckets are in the plane of the stream, in the manner substantially and for the purposes described.

"2. In a water wheel driven by an impinging jet, or jets of water, a series of buckets attached thereto, formed with a double curve in their transverse section, curved also in the plane of rotation, to present curved or convex faces normal to the impinging water in that plane, the outer ends of the buckets open in the form of a trough, in the manner and for the purposes substantially as described.

"3. In a water wheel driven by an impinging jet or jets, a series of buckets attached to its rim, the buckets having a double curve in their transverse section, and a backward curve in the plane of rotation, as herein described ; the outer ends of the buckets open in the form of a trough, and the extreme end of the bottom and sides beveled to an edge so as to cut the jet transverse to its course, without disturbing the stream in entering, in the manner substantially, and for the purposes described."

Analyzed, these claims comprise "backward curved" buckets that present faces normal at all points to the line of the water's

impingement; also buckets open at their outer end, that is, without obstruction to the resultant flow or reactive course of the water in a plane transverse to that of rotation, and also the entry of the buckets by sharp edges cutting transversely into the stream.

Here are three distinct features differing from former practice, and directed mainly to the attainment of uniform conditions throughout the working range of the buckets, and there seems only a single reason why this should not end the search after theoretical buckets, at least with an amount of water or size of the jet that will permit an uniform action of the whole mass, and a reacting angle as nearly as possible in the plane of rotation.

The loss may be little or none when the wheels are operating under correct conditions. This, experiment alone can determine. No doubt there are many who would attempt at once a mathematical solution of the whole problem, and this would be simple enough if the buckets were fixed, but able hydraulic engineers, and we may mention among this number Ross E. Browne, of San Francisco, who, after much careful observation, admits that the phenomena attending on the operation of these wheels cannot well be arrived at or predicated from computations.

The writer applied to Mr. Berry, the inventor of the buckets last described, for an analysis such as he could furnish, of the action of the water on his form of buckets. The following is in substance the remarks received from him, together with diagrams to assist in explanation :

"In that class of impulse water wheels that may be called reactive tangential, that is, wheels that provide for a reversal of an impinging stream, the conditions that contribute to a high efficiency are: (1) a tangential application of the stream or jet; (2) a short path for the water on the surface of the buckets; (3) easy curves adapted to the change of course and velocity; (4) entrance of the stream without disturbance or shock; (5) a discharge of the water as nearly as possible reverse to its entering course, and tangential to the wheel; (6) that these conditions should change as little as possible during the passage of the vanes or buckets through the stream. These conditions are as nearly as possible filled by the form of buckets shown in the following diagrams.

Complete tangential application of the water to wheels of this class is, except at one point, impossible. This is illustrated by the diagram Fig. 8, in which A is the line of the stream, B a radial line through the center of the wheel at a right angle to A , and C a point at which the center of a "severed section" of the stream will meet the bucket. The rotative effect of this water will be as the cosine of the angle formed by $A B C$. This is shown in a greater degree

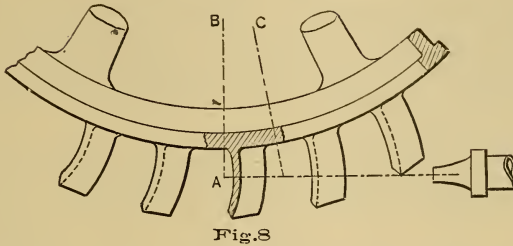


Fig. 8

in Fig. 9, and may cause a good deal of loss if there are too many buckets.

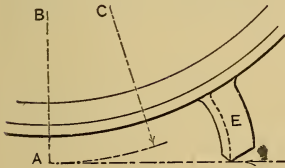


Fig. 9

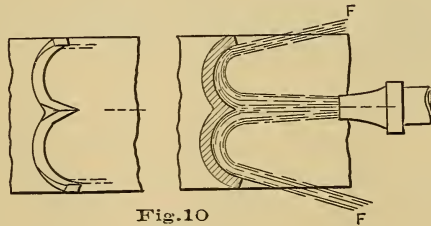


Fig. 10

The frictional faces of the buckets should be as short and present as small an area as is possible, and smooth; two matters that have not always received the amount of attention they should in designing these wheels. The present form of the buckets permits them to be cheaply machined or finished by means of rotary milling tools, if the curves or faces are arcs of true circles, as seen in Fig. 10, which shows a transverse section and an outer end view of one of the buckets. The axis of the cutting tool would be at the center from which the curves are generated, and the feed movement of either the work or the tools would follow the curved lines *E* in Fig. 9.

The angle *F* in Fig. 10, I make to depend upon the pitch or distance between the buckets as indicated, but this may not be important when a wheel is moving at a proper speed with relation to the water, or at $4\sqrt{H}$ in feet per second, which is considered a

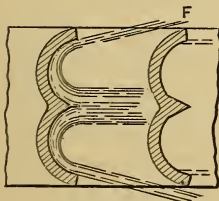


Fig. 11

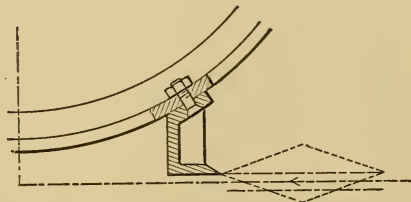


Fig. 12

proper velocity. This should leave energy enough in the discharged water on the line *F* to project it clear of the next approach-

ing bucket, as shown in Fig. 11. The theoretical loss by the divergence of the lines F from that of the stream does not amount to much, certainly not one per cent. at a proper speed of the wheels, there being really no velocity to be considered when the wheels are running at a proper velocity.

Tangential discharge of the water from the buckets in the plane of rotation, is another point that seems to have met with but little consideration in water wheels of this kind. I had prepared diagrams to show the discharge in this plane with the present form of the buckets, but will not send them because the result is obvious, so long as impingement of the water is against surfaces normal to the stream, the discharge being as nearly tangential as possible. With concave buckets, or those having closed ends, the discharge is at various angles and so erratic that at any speed wherein reaction is an element of work or propulsion, the loss is obvious.

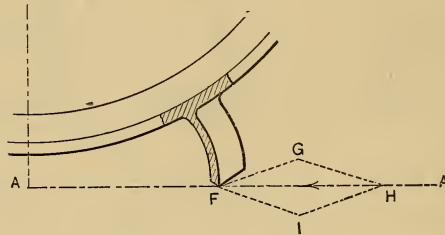


Fig. 13

The determination of the actual as distinguished from the apparent angle of impingement, is another feature of some importance. Referring to Fig. 13, let AA represent the line of the stream or jet; F the point of the bucket's contact; FG tangent to the point F . Supposing the bucket to be moving at half the speed of the water, the direction and speed of the bucket at F is represented by GF , while HF represents the direction and speed of the stream; completing the triangle gives HG or IF as the direction of the stream in relation to a bucket at rest, and from IF must all diagrams relating to tangential discharge be determined.

In respect to non-disturbance of the stream I assume that a thin edge entering it transversely is better than any entrance made at an angle as in Fig. 12, or any of the forms hitherto adopted, because not only must disturbance be taken into account but also the effect produced by the diverted water while the stream is being severed. The two things must be considered together. The value or effect of disturbance is much more complex than the losses due to mis-directed water, and while it may be difficult or impossible to arrive at conclusions inferentially, observation of a wheel's action will indicate at once any fault or loss from either of these causes."

This, and much more besides from Mr. Berry, not requiring quotation here, indicates that he has prosecuted his investigations in a very intelligent way.

Another feature of this new form of tangential buckets is that their shape permits the jet or stream to be applied at varying distances from the center of the wheel without any considerable change of the reactive or resultant angles of discharge, and consequently without impairing efficiency. This enables regulation of speed by adjusting the nozzles, which cannot be done with concave buckets without disturbance and change of the conditions under which a wheel operates.

The writer will not assume to determine farther than by inference, what the result may be of this considerable change in the design and method of constructing tangential water wheels, but will venture the opinion that in any case where the volume of water used is such that a jet or jets can be reduced to a small section, so that the whole stream will follow the reactive curves of the buckets, such wheels will give a higher percentage of useful effect than can be attained with any other type of water wheels now known.

The Pelton Water Wheel Company, of San Francisco, who control the patent on these new buckets for the Pacific side of the country, will soon conduct experiments to determine in actual practice what can be attained by the system, and will, no doubt, use such buckets in some experiments to be made by them under direction of the U. S. Navy Department for the transmission of hydraulic power on war vessels.

The commercial phase of this water-wheel problem, while not a technical subject, must, in this practical country, be taken into account. It will not be pursued here farther than to say that compared to pressure turbines the tangential water-wheel plants in California do not cost per horse power more than one half as much as pressure turbines, and their maintenance not one fourth as much. The speed or size of a tangential wheel can be varied at pleasure; so also its power, by simply changing the nozzles.

The wooden frames and other features of crude construction incident to an enforced cheapness and temporary or uncertain uses in mines, have done much to convey wrong impressions, and to divert attention from the true nature of the wheels and their merits, so it may be said that while the art or manufacture of such water wheels has been going on for ten or fifteen years past under forms that gave a high efficiency, the fact has been hardly realized in a general way. The future promises a good deal more. A water wheel without metallic contacts, without water-retaining joints, costing much less to construct, giving a higher efficiency and greater adaptation

in the way of connecting than the turbine class, will not be long in finding its place in the engineering world.

To these remarks on tangential water wheels may be appended with advantage some generalizations or inferences respecting water motors. If one considers as an abstract problem the conversion of the weight of a descending body, mobile in nature, into rotative energy applied to a shaft or axis, the inference will be that no complexity or great variation in methods is probable.

If one will then refer to the literature of this branch of mechanics; for example, 365 pages of Weisbach, translation of 1880, devoted to water motors, and see the wonderful number of forms under which machines have been devised for this simple purpose; then examine page upon page of complex formulæ which endeavor to explain the phenomena of action in these machines, the conclusion must be that man's weak powers are incompetent to deal intelligently with the most simple of natural forces. There must also be the conclusion that mathematical treatment, however great its pretensions, can contribute but little to practical results, in fact, has not explained in a practical manner so as to command confidence, the forces that are set up in the action of turbine wheels, whether impulse, pressure, or reaction are principal, existent or non-existent.

If it is assumed that the best conditions of operation or the true theory of water wheels, can be deduced from computation, we may ask why has not the best type in each class been established? Also, we may ask, how can confidence be established in methods that can not explain and would condemn the American inward-flow or center-vent turbine wheels which have given out the same useful effect attained by the refinements of the Fourneyron and Jonval types? And finally we may ask why the simple elements that enter into the form of buckets for tangential water wheels have not been provided for the use of those who construct and use such wheels? The fact is, the scope and function of scientific treatment in so far as water wheels, amounts to an attempt to follow out and explain the forces supposed to be involved and acting. Certain premises are assumed, which if correct, lead to certain results, and no one can dispute that there is a distinct value in such deductions because they lead toward the true path and often save a great deal of wasted effort. To illustrate what we mean an example can be presented.

Mr. Theodore Risdon, of Mount Holly, New Jersey, undertook, about thirty years ago, the improvement of center-vent turbine wheels. He was not a mathematician in the sense of analyzing the action of water in such wheels, but proceeded from observation, making a great number of experiments, which ended in his *reversing the curves* of the receiving vanes in such wheels. There were no mathematics for this, on the contrary the receiving vanes or initial curves, as they may be called, had previously been laid down with great care and rested upon a supposed final law of hydraulics.

He reversed the initial curves, however, presenting a convex face to the entering water, and sent water wheels to be tested at the Centennial Exhibition in 1876 that gave a better result than the most carefully designed Jonval wheels, and better than any other inward-flow turbine wheels, of which a score or more were tried. The Risdon inward-flow turbines stand at the present time, so far as we know, with a record as high as any pressure wheels, even the accurately made Fourneyron wheels by Boydon and Francis. The efficiency for the Risdon turbines at the Holyoke flume in 1874, reached 91.30 per cent. with a full gate, and 72.77 per cent. with a half gate.

We are not arguing against scientific analysis and treatment of hydraulic subjects, but contend that it is high time that science should take the initiative and determine at least "something" in water wheel practice that would stand as immutable rules in the future.

Of American inward-flow turbine wheels, not less than thirty different kinds are made at this time, and there is certainly no reason for this. There is only one correct form for such wheels, and the diversity of designs shows unmistakably that the perfect form is not known, and that there is a want of confidence in the data that exists respecting turbine action. The difference in the construction of such wheels is marked, while their relative efficiency does not vary more than 20 per cent., if so much.

APPENDIX.

Since the foregoing article was written the author has happened upon a drawing showing an early form of partial turbines by Messrs. Escher, Weis & Co., of Zurich, Switzerland.

Fig. 14 is a vertical section and partial plan of these wheels as constructed in 1860 by the firm named, for various permanent works

in Europe. The efficiency attained was from 60 to 65 per cent., which, considering the arrangement or design indicates a careful attention to workmanship and proportions.

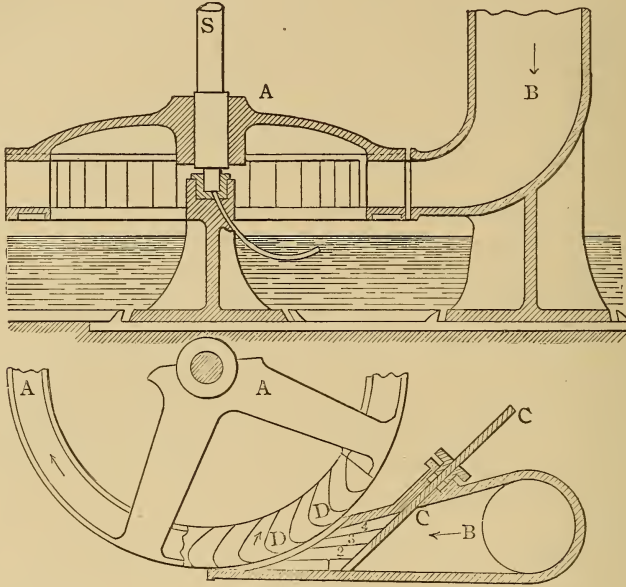


FIG. 14.

The wheel is described as one with a single jet or chute *B*, controlled by the diagonal slide *C*. The numbered lines are added, no doubt, in making analysis of the water's action. The discharge is inward through buckets or vanes, not conforming, as will be seen, to what are now considered the curves of greatest effect.

The general proportions of the wheels were based upon the head and volume of water by the following formula :

$$R^2 = 5.5 \frac{M}{\sqrt{H}}$$

in which R = radius of the wheel outside. M = cubic meters of water per minute. H = the fall or head in meters. The interior diameter was from .75 to .80 per cent. of R , or the extreme radius.

REWARDS FOR MERITORIOUS DISCOVERIES AND
INVENTIONS.

The Franklin Institute, of Philadelphia, Pa., has issued the announcement below, to which we desire to call the attention of our readers on this Coast. There have been, and are now, many important and useful inventions here that may be presented to the Committee on Arts and Sciences, and receive recognition and advantage by the awards below explained.

"The attention of ingenious men and women is hereby directed to the fact that the Franklin Institute of the State of Pennsylvania, for the promotion of the mechanic arts, may grant, or recommend the grant of, certain medals for meritorious discoveries and inventions, which contribute to the promotion of the arts and manufactures.

The character and conditions of these rewards are briefly stated in the following :

The Elliott Cresson Medal, founded in 1848 by the gift of the late Elliott Cresson. This medal is of gold and by the terms of the deed of trust may be granted for some discovery in the arts and sciences, or for the invention or improvement of some useful machine, or for some new process, or combination of materials in manufactures, or for ingenuity, skill or perfection in workmanship.

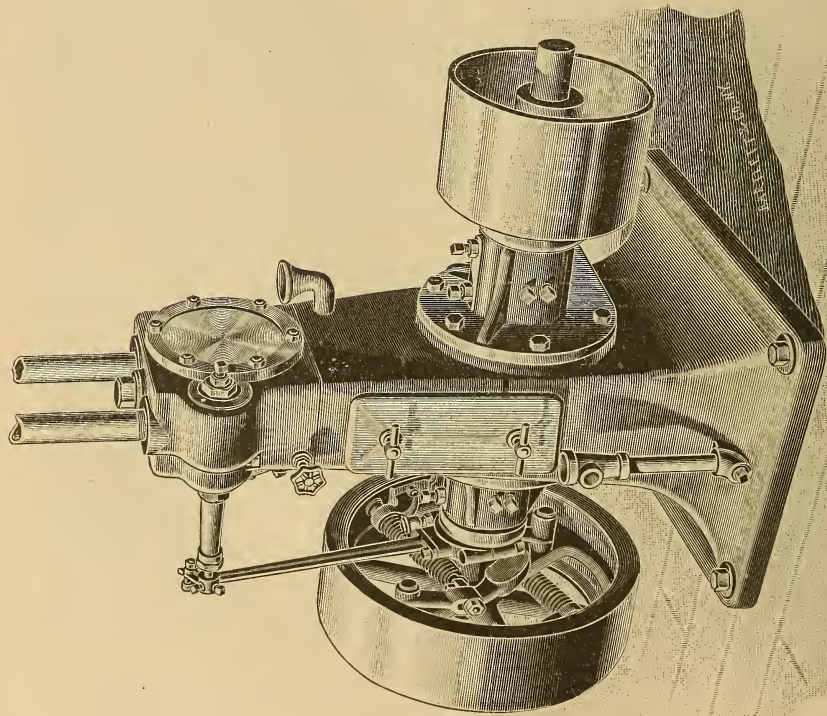
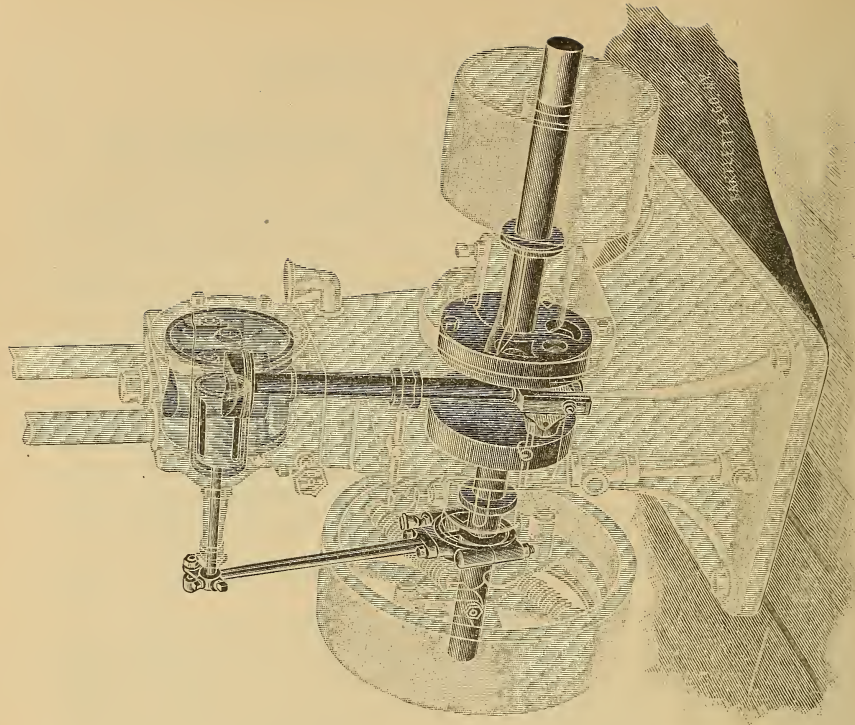
The John Scott Legacy Premium and Medal (twenty dollars and a medal of bronze), awarded by the City of Philadelphia. This medal was founded in 1816 by John Scott, a merchant of Edinburgh, Scotland, who bequeathed to the City of Philadelphia a considerable sum of money, the interest of which should be devoted to rewarding ingenious men and women who make useful inventions. The premium is not to exceed twenty dollars, and the medal is to be of copper, and inscribed "To the most deserving."

The control of the Scott Legacy Premium and Medal (by Act of the Ordinance of Councils in 1869,) passed to the Board of Directors of City Trusts, and has been referred by the Board to its Committee on Minor Trusts, and that Committee has resolved that it will receive favorably the name of any person whom the Franklin Institute may from time to time report to the Committee on Minor Trusts as worthy to receive the Scott Legacy Premium and Medal.

The Edward Longstreth Medal of Merit, founded in 1889, by Edward Longstreth, machinist and late member of the Baldwin Locomotive Works. This medal is of silver, and may be awarded for useful invention, important discovery, and meritorious work in, or contributions to, science or the industrial arts.

Full directions as to the manner and form in which applications for the investigation of inventions and discoveries should be made, will be sent to interested parties on application to

WILLIAM H. WAHL, *Secretary*,
FRANKLIN INSTITUTE, PHILADELPHIA, PA."



HIGH-SPEED AUTOMATIC STEAM ENGINE.—THE J. T. CASE ENGINE CO., NEW BRITAIN, CONN.

HIGH-SPEED AUTOMATIC STEAM ENGINE.

THE J. T. CASE ENGINE COMPANY, NEW BRITAIN, CONNECTICUT.

The engravings opposite, showing an elevation and skeleton view of a peculiar steam engine, invented by Mr. J. T. Case, of New Britain, Conn., will be a matter of interest to our readers. We believe that on the score of novelty this engine may take a first place among the many attempts in late years to simplify steam-engine construction without abandoning or ignoring any of the essential features of endurance or economy.

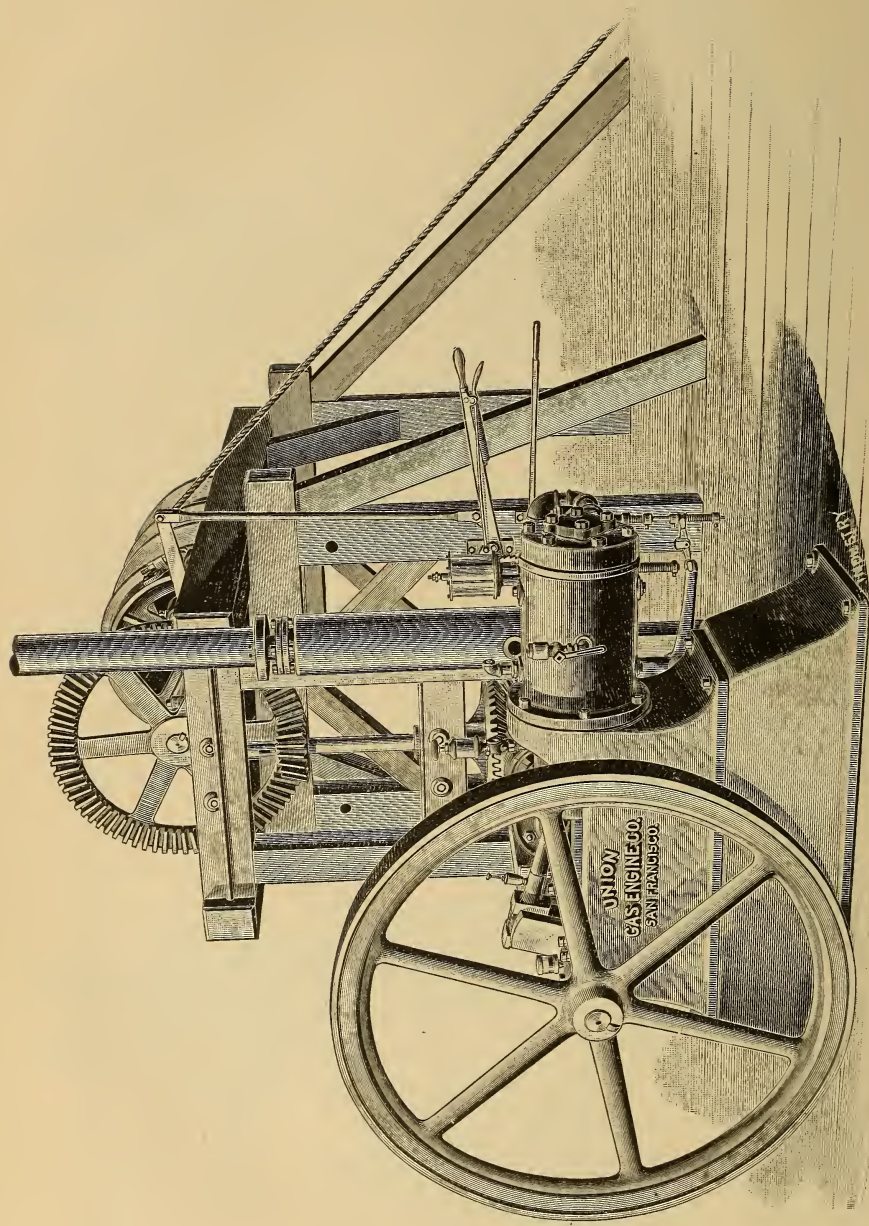
At first glance one will be disposed to class the engine with others of the pendulous or oscillating class, subject to strains upon trunnions and steam-packed joints, with large frictional surfaces and so on, but the operating features when studied, disclose a remarkable freedom from faults thought to be inherent in engines of the class, or appearance rather, because there is really no class to put the present one in.

The cylinder, to so call it, is an oscillating member pierced transversely to receive the piston, and forming, in a sense, trunnions, but there is no strain transverse to the horizontal axis. The upper end being open, as seen in the skeleton view, the strain of the pressure on the downward stroke falls on the cylinder cover, while on the inward or upward stroke a film of steam is admitted to shallow chambers beneath the cylinder or trunnions that counterbalances the thrust on the piston, so the oscillating trunnion cylinder is all the time in equilibrium.

This oscillating member performs the function of fixed steam distribution, and the cylindrical valve, seen in front, acts as a cut-off for regulation, and to govern the rate of expansion. The resistance by inertia to the oscillating movement is reduced to a minimum by reason of the shortness of the cylinder, and is provided for by a long sleeve extending down around the piston rod, half way to the crank, as seen in the drawing.

Analyzed, the engine may be said to be an oscillating one, with an open-ended cylinder, the trunnions as large in diameter as the cylinder's length, relieved from strains, without packed joints, and having a long range of movement so as to attain free and efficient valve movement. The crank shaft, connections, bearings, regulating mechanism, main bearings, and other details are all made with ample proportions, and in accordance with good practice.

These engines are made either throttling or automatic, from $2\frac{1}{2}$



GAS ENGINE HOISTING PLANT FOR MINES.—UNION GAS ENGINE CO., SAN FRANCISCO.

to 25 horse power, on pedestal frames as in the drawings, with brackets to bolt to walls, or for suspension beneath beams or ceilings. They are also made double, with two cylinders close together, and run at the highest rate of speed that has been attained with reciprocating engines, reaching 550 to 900 revolutions per minute. The business has been founded as a "manufacture," with duplication of parts and standard dimensions. These engines, it seems to us, are especially suited for boats, being made reversible by their valve arrangement, without links or external gearing, but their special adaptation is to what the makers call direct connection to line shafts and machines that are required for use separately.

GAS ENGINE HOISTING PLANT FOR MINES.

UNION GAS ENGINE CO., SAN FRANCISCO.

One especial adaptation of gas or gasoline engines is for mining purposes in situations where fuel has to be transported long distances, or to mountainous places difficult of access. The proportion of weight compared to coal or wood is about 1 to 5, and the convenience of carriage is much in the same proportion. The machinery is exceedingly simple, as may be seen in the opposite plate, furnished by the Union Gas Engine Company, of this City, illustrating a hoisting plant made by them for a mine at Grass Flat, Sierra County, California.

The clutches and brakes are operated by the levers seen on the right, the whole consisting of an engine, gallows frame and winding drum, driven by two pairs of bevel wheels. The gallows frame can be set over a vertical shaft, or a rope may be led off at any angle, as shown in the drawing. The engine frame, fly wheel, and other parts, can be made in sections so as to come within the limit of a burro load of 300 pounds, and one "burro" can carry enough fuel to operate an engine of 12 horse power for 3 days of 10 hours.

The machinery is always ready to start, and the consumption of fuel is limited to the actual work done, or at least there is but little waste when the work is intermittent. There seems to be various economies in this arrangement, for small mines at least, and a considerable saving in first cost over steam power.

LESSONS FROM THE FINANCIAL PANIC.

Mr. David A Wells contributes to the *Forum* for January, an article on the "Teachings of Our Recent Economic Experiences," that more than any literature that has appeared, will give people some insight into the true circumstances of present financial and trade depression in this country.

We had occasion in the December issue of this Journal to say something of Mr. Wells' powers as a financier and his understanding of National revenue matters, and of the signal service he rendered during the darkest hours of the Civil War, when the country was nearly bankrupt.

Mr. Wells' statistics respecting the present panic, it may be called, are astonishing. In 1890-91 over \$21,000,000 was paid in premiums over nominal value to redeem immaturred bonds. The revenue was so great that no better way appeared to consume it. Now instead of this there is a deficit of \$30,000,000 or more to make up in some way. From May 4th to July 12th of last year \$194,000,000 of deposits were drawn out of the National Banks alone, and up to October these withdrawals reached \$378,000,000. Of this amount \$299,000,000 were personal deposits. The withdrawal of funds from banks of all kinds, if added together, Mr. Wells places at \$500,000,000, Bank loans were called in to the amount of \$318,000,000 from January 1st to October 31st; 585 banks and banking institutions suspended payment, but of these 171 resumed. During this period \$1,200,000,000 worth of railway property went into the hands of receivers.

By loss in prices, loss of labor and from all causes, Mr. Wells estimates that the present panic has cost the country "one thousand millions of dollars."

In respect to causes, it is common to claim that we are suffering with other countries and the depression is general. This is not true. The causes are inherent in our own economic system. Our nearest neighbor in the north, Canada, where business is analogous to this country, has had no panic and no disturbance even, except by reason of failures here. Mexico, our neighbor on the other side, a silver producing country, has not only no panic, but is in a very prosperous condition compared with some years preceding.

The rate of money, which is always a measure of sound financial conditions, has been no higher in England, and not even

in the Argentine States where confidence is sensitive from experience of two years ago, has there been any disturbance. The facts are enough to show beyond any question, that the present circumstances are a result of purely local causes, which the people persistently refuse to discern. Mr. Wells in respect to this, says:

"The most appalling ignorance prevails in respect to the above and all other economic subjects; and not only among the masses, but among many who are filling important stations as legislators, editors, and educational directors and teachers. And under such a condition of things it is almost hopeless to expect that fundamentally clear and correct ideas, or ideas remedial of specific evils, will ever be embodied in our financial or economic legislation; or that an end will be put to constantly recurring but needless losses to the Nation—losses that each and every year represent more than the capitalized wealth of all its universities, colleges, and high schools; or that a stop will be put to needless inequalities in the distribution of wealth that in the midst of unparalleled natural abundance makes and keeps large masses of our people poor."

To warrant so broad an assumption as the above, the author quotes from a decision of the U. S. Supreme Court, that said:

"The obligation of a contract to pay money is to pay that which the law shall recognize as money when the payment is to be made."—*Opinion of the United States Supreme Court, 1870, 12 Wallace, p. 553.*

The same decision held that value "was an ideal thing," and that the substance, whatever it was, with which debts were paid, need not have intrinsic value. This remark, it must be remembered, does not apply to representative values, such as checks or notes commanding coin or other commodities having intrinsic value, but to what is called "fiat money," that represents nothing.

The circumstance is absurd, considering that no legislative power in the world can create a dollar of abstract value of any kind that people will respect or receive as money independent of intrinsic value, or the command of intrinsic value.

STEEL BARRELS.

After a great many experiments, the manufacture of steel barrels for liquids may now be said to have reached a successful point, that is, the shape and nature of the common barrel is retained, and metal substituted for wood. The barrel, in its essential features, like a

blacksmith's anvil, is the result of centuries of evolution. It is one of the most complete of all devices. On its side it can be rolled more easily than a perfect cylinder. The "tread," so to call it, is proportioned to the weight, and permits rolling in any direction. A longitudinal rocking motion permitted by the bilge enables one with ease to set on end a barrel of 300 to 400-pounds weight. The reduced diameter at the ends permits it to be easily thrown down again on its side.

There has been little success in making new kinds of barrels out of metal, but now the true barrel has appeared, made of steel, and will no doubt remain an increasing article of manufacture, especially for such volatile fluids as cannot be held by wooden staves without sizing or painting the inside.

The sheets are curved, welded by electricity, and the bilge rolled in without heating. The heads are corrugated by stamping, for stiffness, set in with a small reinforcing ring or hoop, both inside and outside, and the whole welded together, so the barrel when complete is one solid piece of steel, except a screw-bung set in a reinforcing ring either at the bilge or end, or both.

For petroleum these barrels are made to hold fifty gallons, another very sensible idea, and the manufacture should be taken up in this country as soon as possible. It is claimed they are now being very successfully produced in England.

RETAINING SEA WALLS.

A common idea of sea-resisting walls, is that, to be secure they should be laid in mortar or cement. This is a mistake, for any but work built up from immovable foundations. Mr. J. Wiggins, who prepared one of Weale's series of text books, says of sea embankments :

"In treating of the proper substances for facing, it will not be irrelevant to mention those which, though sometimes used, are found to be improper for this purpose. Such are all kinds of cement, or material laid in cement, which, however tenacious, sooner or later inevitably crack and break away, or become undermined and lose their earthy support, from the continued agitation of the sea and the constant change which the earth of the shore is undergoing. Hard materials, therefore, with a firm natural individual bearing on the soil, which are thus free to regain that bearing

when disturbed, are the only substances to be depended on without incessant renewal."

The integrity of a sea embankment as usually made, that is, erected on the natural bottom or surface, depends on flexure, and this again on slope. The greater the slope the less disturbance by flexure, such as is produced by irregular settling, besides the force of impinging waves is as the outer angle.

The masonry of such walls, if in any degree as close as is necessary in walls built with mortar, will prevent washing through the interstices, and thus sweeping out earth or clay filling behind.

The expense is another consideration in favor of loose or uncemented walls or embankments. Leaving out the cost of foundations, which commonly will cost as much as the superstructure in sea walls, the cost of the wall itself is not more than one half as much as one built with mortar or cement, so the proportion between the cost of a mortar and a loose wall is as one to four.

HORIZONTAL GAS ENGINE.

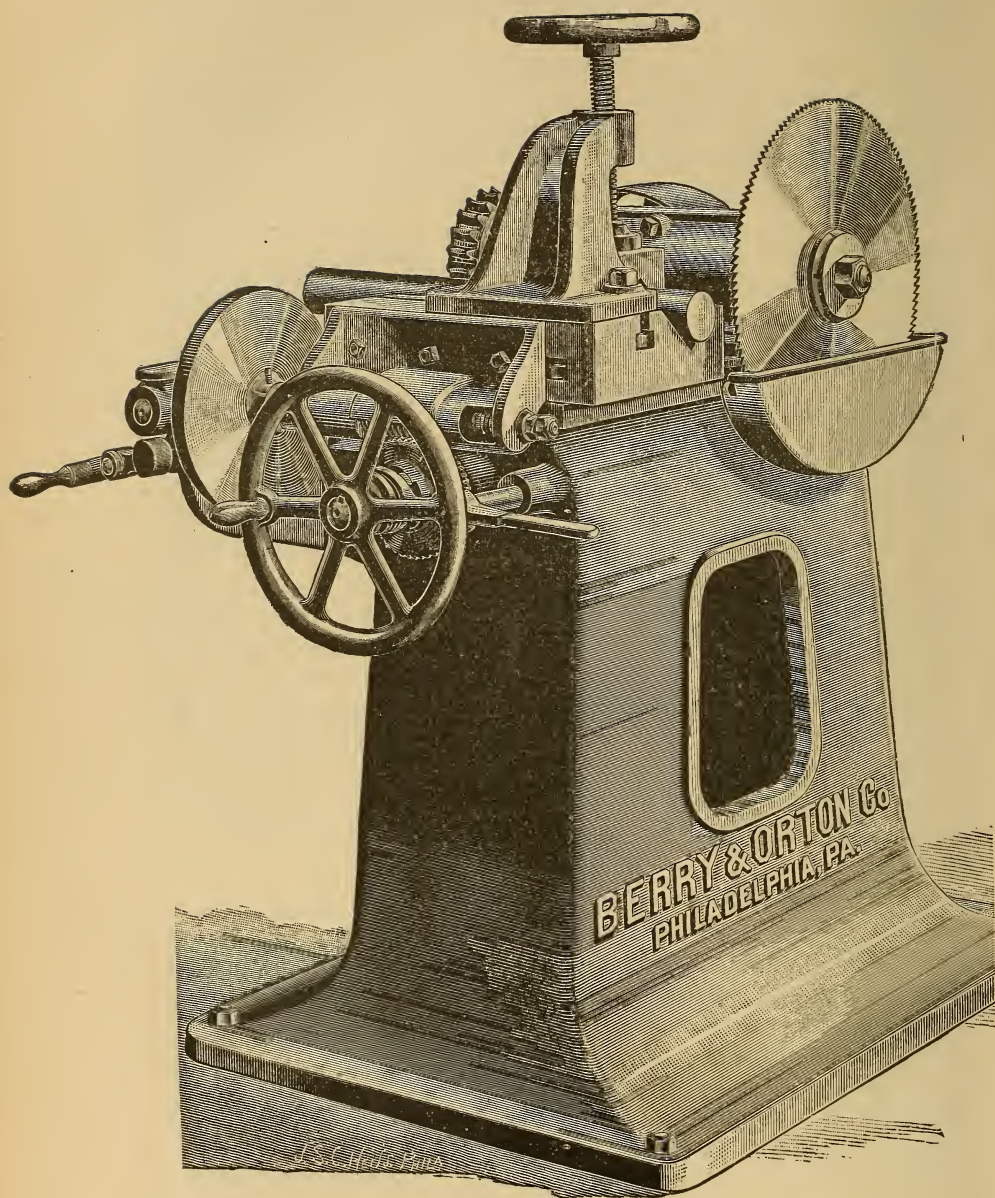
[Frontispiece.]

97K

The above referred to engraving shows in perspective a gas engine of twenty horse power, made by the Union Gas Engine Co., of this City. The plate answers a double purpose, it shows the latest designs and practice of the company, and a good example of wood engraving, respecting which some remarks appeared in our last issue.

It will be noted that in the course of evolution gas-engine framing has approached all the time nearer to what may be called a standard form, wherein symmetry, strength and accessibility are affiliated, good fitting following in the same proportion as is always the case. It may be difficult to explain this, except on the assumption that whatever "is right" in respect to strains and proportions "looks right."

In the present case, it may be seen, there is not a curve or "kink" that has not some obvious purpose, and not a pound of metal for ornament. We hope the machines are painted with lusterless paint, as nearly the shade of the castings as possible. The various details of the engine for heating and carburetting gasoline, the valve and regulating movements and devices all fall naturally into place, and harmonize with the main structure.



METAL-SAWING MACHINE.

THE BERRY & ORTON CO., PHILADELPHIA, PA.

METAL-SAWING MACHINE.

THE BERRY & ORTON CO., PHILADELPHIA, PA.

The development of cold sawing iron and steel has taken place, in so far as any wide use, during a dozen years past, and should go far toward convincing us how little after all we know of manipulative processes, and how they are left to be discovered by accident.

It will be safe to conjecture that for a century at least, the fact of a wood saw being destroyed if it came in contact with iron, deterred people from applying such saws to cutting iron, although the hack-saw was all the time proof of how rapidly iron could be cut with a proper saw at a slow speed. It is merely a milling or planing operation, obviously possible and practicable if reasoned about, but it was left for tentative development.

One of the first uses in this country was in cutting off "stock" for machine drills, the hardest kind of cast steel bars, and one of the most difficult things to saw. In the old world it also came in a "left-handed" way, because the use of circular saws, now principally employed, followed the use of band saws, but when circular sawing once started, about ten years ago, it spread within three years or so far and wide. American machine-tool makers were late in taking it up, but have made up since by some very ingenious designs, among which is the one illustrated on the page opposite, and to which attention is now called.

The machine is to cut off square or round bars to five inches diameter, and is, in a good many respects, an unusual adaptation of machine motions and functions with the fewest possible parts. The positions and movements seem to fall into place naturally and completely.

The saw is driven by a tangent wheel, seen over the top, meshing into a strong worm shaft at the side of the machine. The saw spindle is on a movable carriage, and the tangent gearing provides for the traversing of the carriage and saw.

On the worm shaft is a movable friction pinion that drives the disc wheel on the left, at varying speed as the pinion is adjusted by the handle on the extreme left. The large hand wheel in front is on the end of a central feed screw that moves the saw carriage. This feed screw is driven by the tangent gearing in front when the machinery is operating, or is disengaged by a clutch and the hand

lever on the right, so the saw can be moved forward or back quickly by the large hand wheel.

The planes of the several shafts permit the employment of three sets of tangent gearing, and the reduction for feed, which is very slow, is placed at control by this gearing, and is varied, not by steps, but in regular progression each way, as the work demands.

We have here a traversing carriage and saw spindle, variable power feed and hand movement of the carriage, with but a single member provided for transmission alone, that is, the small cross shaft in front of the machine. All moving parts are covered from dirt and chips; there are no feed bolts, cones, or other contrivances, and we venture the opinion that the design of this machine has not been excelled in this country or elsewhere for one of its class and purpose. There are three sizes made, of the same general design.

PROPORTIONS FOR WOOD-PLANING MACHINES.

Mr. Jonathan Torrey, writing in the *Woodworker*, has some pertinent remarks in respect to the methods of fitting up wood-planing machines, and finds fault with a driving shaft having half a dozen pulleys on it, all held by set screws, also other pulleys on the cutter spindles, held in the same manner, and even ventures to question the propriety of employing a driving shaft two inches in diameter, with six belts on it.

Mr. Torrey's mistake, if he makes any, is that he does not own all of the planing mills that purchase machines. If he did, they would be differently fitted up and perhaps would plane boards right side up and right end foremost. He wastes so much of his very useful letter as applies to a previous correspondent who figured out dimensions for planing-machine shafts and spindles on the basis of torsion, or deflection even. Such rules do not apply to wood-working machines, and are not regarded by any maker, however scientific he may be.

In the case cited by the writer, where pitch-pine planks 4×12 inches were dressed all over, tongued and beaded, at the rate of 50 lineal feet per minute, with driving bands four inches wide, seems incredible. The bands to the cutter spindles, six of them, should have all been six inches wide, and this would make up thirty-six inches of width from a shaft two inches in diameter.

The speed of such bands is commonly from 3,000 to 4,000 feet per minute, and assuming a fair estimate of 80 feet of belt surface

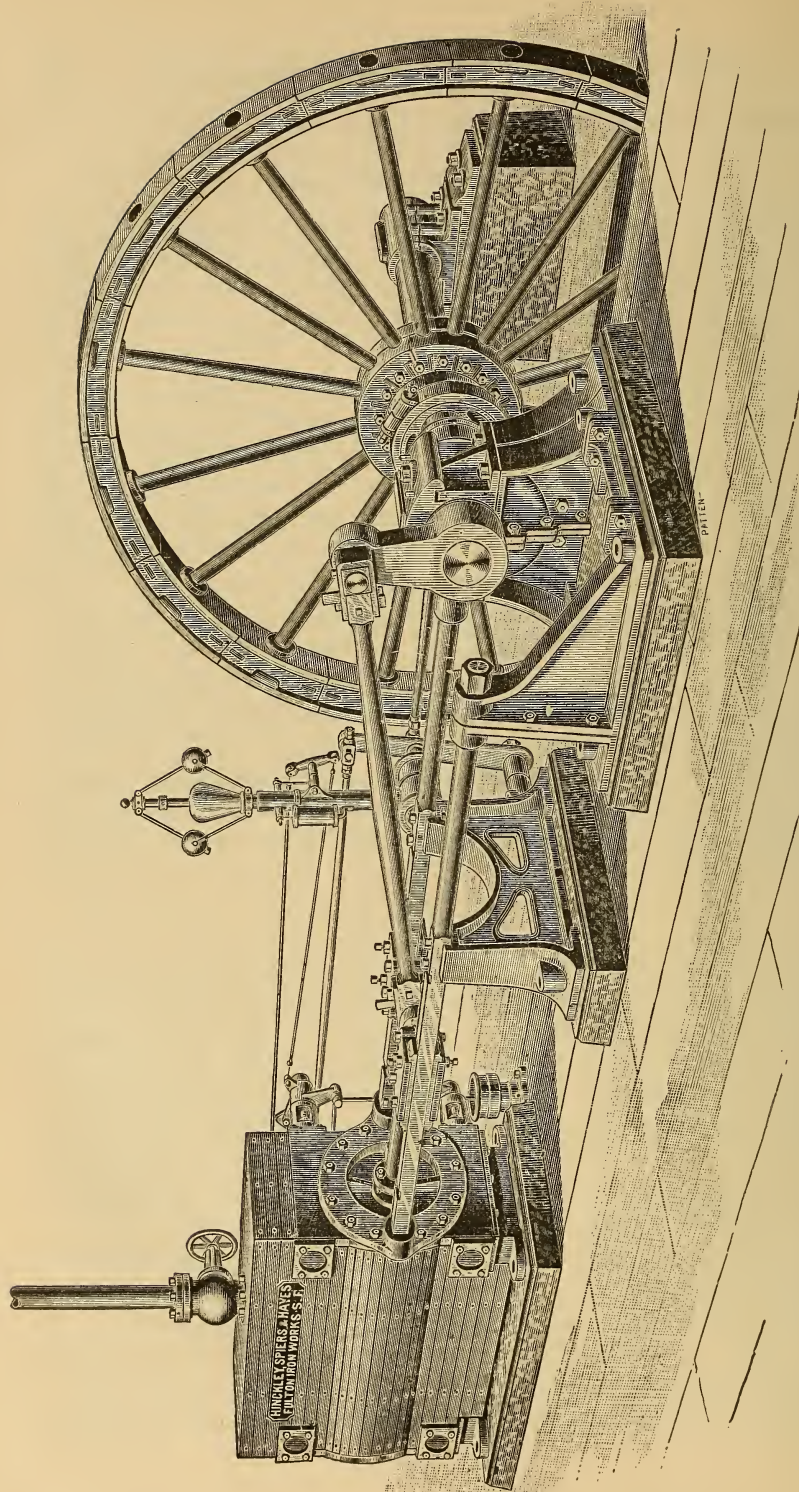
per minute to one horse power, the result will be

$$\frac{4000 \times 3}{80} = 150 \text{ horse power.}$$

Such a rule does not apply, however, because the contact on the spindle pulleys is but a fraction of their circumference, and that dry, with a cloud of dust and shavings passing under the belts, but the lateral strains on the driving or machine counter-shaft is what the 24 or 36 inches of belt width calls for.

The shaft on Mr. Torrey's machine should be three inches in diameter, except in the bearings, and these should be half an inch less, or $2\frac{1}{2}$ inches in diameter. We cannot refer to any formulæ for these proportions, and do not need any, but will certainly adopt them if we ever have a machine to make for Mr. Torrey. There will be no pulleys fastened by set screws in the manner he describes. In some places this slovenly manner of holding pulleys will do, but if nothing more, the set screws should bear on a thin key resting on a corresponding "flat" on the shafts. A proper key-way is best, not a standard one equal to one fourth of the shaft's diameter, but half of that, and the set screws should not, as Mr. Torrey suggests, be opposite the key, but on it, otherwise the key will require a fit in two dimensions, and call for very accurate fitting, or else be tapered and drove. A machine, however, to plane 4×12 inch hard wood, consuming, or provided with 25 horse power, instead of weighing 3 to 5 tons should weigh 15 to 20 tons.

Messrs. J. H. Graham & Co., of Rochester, New York, have made a "break" in the method of planing flooring and other matched stuff, by putting an under cylinder ahead of the top one to form a face before the boards are thickened or matched. This is certainly a common-sense method, but they put another cutting cylinder last to give a light finishing cut on the under side or face. If we were purchasing one of Messrs. Graham and Co's machines we would buy it less the last cylinder, for a discount on the price, or would neglect to provide a belt for that one. The first under cylinder will make a face as smooth as a second one will, because the amount cut away is constantly the same, and must be deep enough to go under the dirt or scale. We imagine that anyone operating the machines will soon find this out. It is seventeen years since we discussed this matter with Mr. Graham, who then deplored the custom that compelled him to make his planing and matching machines wrong end foremost.



SECTIONAL CORLISS ENGINE.—FULTON ENGINEERING AND SHIP-BUILDING WORKS, SAN FRANCISCO.

SECTIONAL CORLISS ENGINE, 150 HORSE POWER.

THE FULTON ENGINEERING AND SHIP-BUILDING WORKS, SAN FRANCISCO.

The drawing on the opposite page shows a very ingenious arrangement of a sectional Corliss engine made to a limit of 300 pounds for the heaviest piece, except the crank shaft.

Machinery constructed in sections, so as to be transported by carrying-mules to stations in the mountains where there are only trails, is an important feature of engineering practice on this Coast, and a perplexing one sometimes.

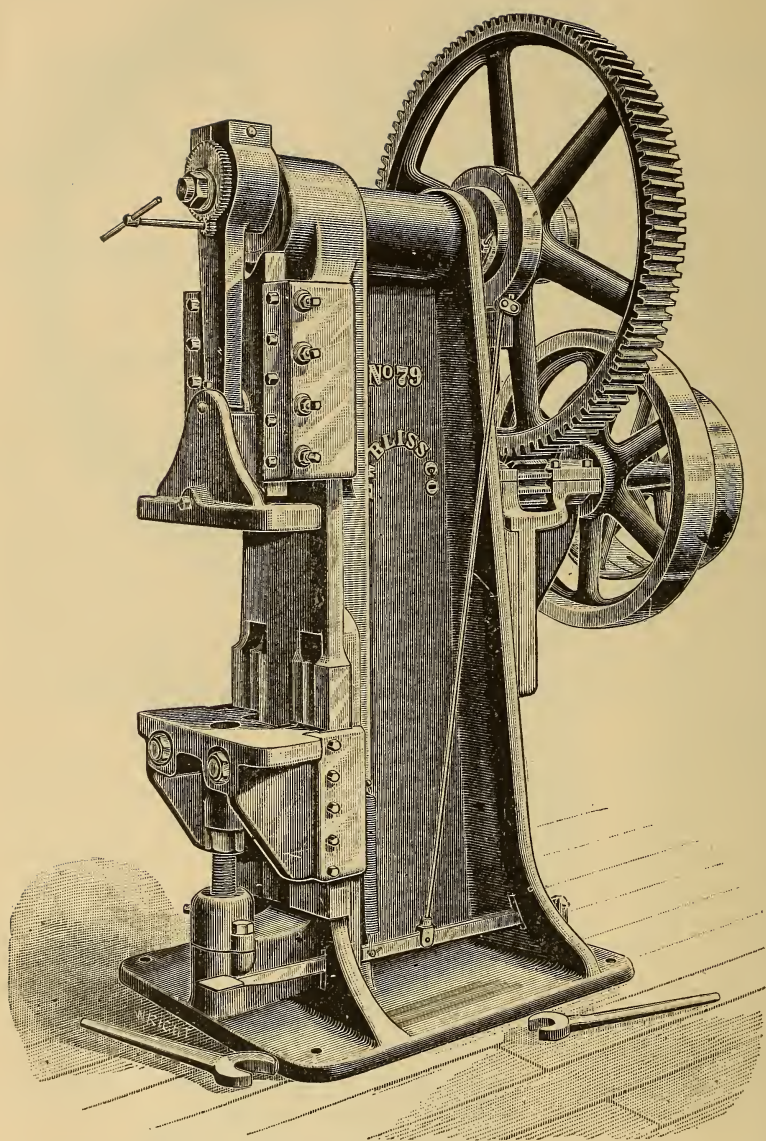
The two main conditions in such work are directly opposed; separation and weight. Segregation increases weight, but is done to avoid weight; so the problem is not confined to dividing the parts, but includes a careful attention to strains, the disposition and strength of material. The chances are that the duty will be severe. When one buys an engine to be transported over mountain passes on "burros" the heating surface and cylinder capacity are reduced to their least limit, which means heavy duty. The present case proves this. The engine, 18" \times 36", when started ran eight months continuously, day and night, with a detention of eight hours or one hour each month, a record that, so far as we know, has no precedent.

The division of the main pedestal and the fly wheel can be followed out in the drawing, but the cylinder, which is in nine or more pieces, being covered in, nothing can be seen except that the contour is the same as for a standard engine of the kind. The cylinder is divided transversely into five parts, fitted together and then bored. The side pipes or valve boxes are bolted on, and the base flanges or base part of the exhaust chamber are detachable.

The central stand supporting the guide bars, which are also tie rods, is in a single piece less than 300 pounds in weight. The main pedestal is divided, as seen, into four parts, and has a central chamber under the main bearing to admit of a radial stiffening flange on the bottom of the bearing, which, by this reinforcement, is greatly reduced in cross section and weight.

The nave of the fly wheel is in eight parts, consisting of four segments on each side of the spokes, the joints "broke" and through bolts, so the nave is thus made into an integral member, and the spokes clamped by the same means.

The spokes of the wheel are round bars of wrought iron, three



LONG-STROKE REDUCING PRESS.

THE E. W. BLISS COMPANY, BROOKLYN, NEW YORK.

inches in diameter, each fastened by a countersunk nut in the fly wheel rim, which is in sixteen sections or segments, as shown, joined by links and keys in the usual manner.

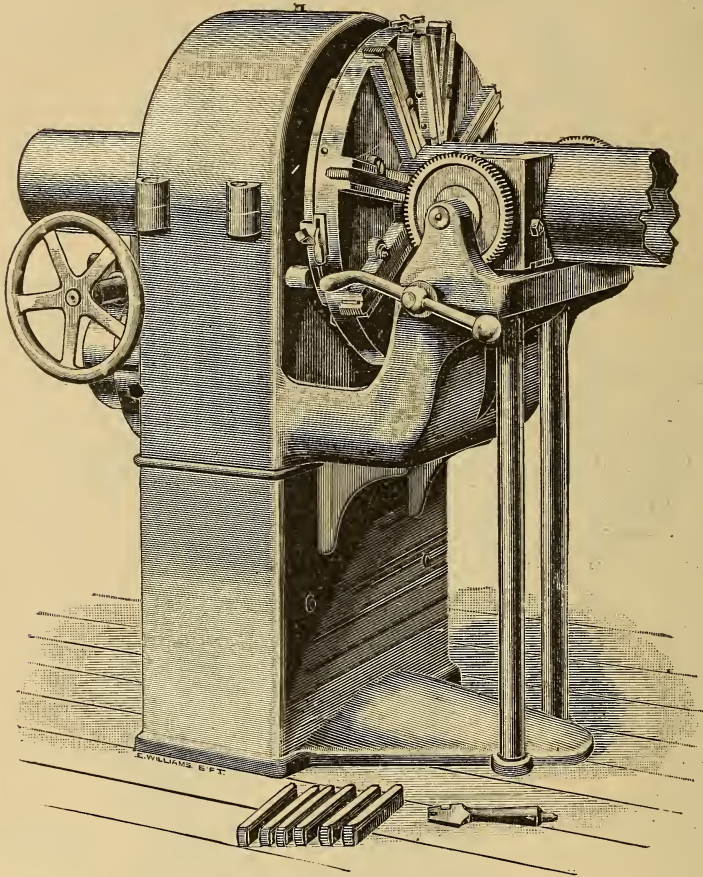
LONG-STROKE REDUCING PRESS.

THE E. W. BLISS CO., BROOKLYN, N. Y.

The annexed cut shows a long-stroke press recently designed by the E. W. Bliss Company, for re-drawing, shaping, trimming and other operations on deep sheet-metal articles. It is provided with a screw adjustment for the table, which permits the use of dies varying greatly in height, and also has an eccentric device in the link which facilitates making the finer adjustments required for the dies. The press is provided with an automatic clutch controlled by foot power, so as to have the slide stop automatically at the top of the stroke, unless continuous strokes are wanted, in which case the foot is kept on the treadle. The machine is made with or without gearing. For broaching castings or forgings, where a very slow movement is required, the machine is arranged with gearing or more power than as shown, in which case a friction clutch on the driving shaft is used instead of an automatic clutch on the crank shaft. The press, as shown in the drawing, weighs about 8,200 pounds, has a maximum distance between the bed and slide of $15\frac{1}{2}$ inches, and 10 inches of adjustment for this space, with a stroke up to 8 inches. The ratio of gearing, as shown, is 1 to $7\frac{1}{2}$, and the number of strokes usually made per minute, 40.

Taking it all in all, no branch of machine-tool work is more perfect than presses. The uniformity of their functions, with simple direct strains, has led to a distribution of metal in the frames, and proportions for parts, that are quite settled, and happily so. The "architectural" designer has little chance on a press frame. There is no place for entablatures, cornices, mouldings, panels or carving, but in some of the very oldest types, long since gone, the designer would work in a doric-fluted column, and patch the working parts on one side.

The E. W. Bliss Company seem to have got down to logical design, and have even discarded the serpentine legs for support, with chromatic embellishment on all available surfaces, that constant exponent of bad fitting.



PIPE-CUTTING AND SCREW-THREADING MACHINE.

THE ARMSTRONG M'F'G. CO., NEW BRITAIN, CONN.

The drawing above shows a very compact machine for cutting off, and making screw threads, on pipes from one to six inches diameter, an unusual range for machines of the kind: This is done with but two sets of double-end dies, equivalent to four sets, however, in so far as diameters.

The clamping mechanism is of a very simple kind, consisting of right and left geared screws operated by the handle at the side. The driving gearing, except the belt pulleys, is all housed in the main frame, secure from chips and dirt. The dies are opened and

closed simultaneously by means of cams, and the longitudinal movement is performed by the hand wheel at the side.

The Armstrong Company are makers of all kinds of dies and apparatus for screw cutting, and seem in this machine to have reached the end of compactness and cost.

PROFESSOR JOHN TYNDALL.

Professor John Tyndall, one of the greatest among modern scientists, died in the first days of the past month. He was an Irishman, born at Carlow in 1820, at first educated by his father, a rigid Presbyterian, and was subsequently at school taught engineering and the applied sciences. His first engineering work was in preparing maps from ordinance surveys, and in laying out railways in Ireland.

Afterward he became a teacher, and finally fell into his natural bent. He remained a teacher through life, not of a school, but of the world, in the most abstruse as well as the popular branches of science. After some time spent in Germany with celebrated scientific men there, he was elected professor of natural philosophy in the British Royal Institution in 1853.

Celebrated among his special studies were the glaciers of the Alps in Switzerland, where many of his later years were passed and where his final work was done.

In 1874, when as president of the British Association, he delivered his famous lecture on the evolution of species, which will even at this time be fresh in the minds of many of our readers. This famous address was resented vigorously by the orthodox world, and brought forth many attacks upon the professor, and unfortunately, because he was of a combative nature, fond of argument, and exhausted much of his vigor in useless controversy.

His distinctive power lay in his methods of elucidation, every one in his hearing could understand what he explained. He was painstaking and exact in everything. His work "Heat as a Mode of Motion," known as widely as science extends, is a fair example of his methods.

His later life was connected with the royal institution, where for twenty-five years he continued his arduous labors. He visited this country and lectured here about fifteen years ago, and on his return to England devoted the proceeds of his lectures to the establishment

of a fund to assist young Americans pursuing scientific studies in Europe, an act of itself showing the generous character of the man and his disregard for all national lines. His charitable acts are not known, further than that they were limited only by his resources.

His late writings, after his retirement from public life, about eight years ago, show the wonderful diversity of his learning. No one has ever achieved such a wide range as Professor Tyndall. It seemed to make no difference to him what subject he dealt with, so long as it was within the realm of truth and demonstration.

Although born in Ireland, the name is certainly of Scotch origin. "Tyn-dall," as we imagine, is equivalent to "Tyne dale," or the valley of the Tyne.

CAST MACHINE BEARINGS.

Some observations on soft metal bearings, met with recently in one of our exchanges, affords an example of how people are apt to measure things by their own environment and experience, oblivious of real facts.

The writer referred to evidently thought that any other than a cast bearing of some soft alloy was an exception and a want of information, whereas such bearings are exceptional and not used in the better class of work. It is true, that by a very remarkable skill in casting machine bearings in this country their use has extended very widely, and perhaps successfully, in a commercial sense, that is they are applied in cases never thought of in other countries—in woodworking machinery, for example.

The true object of such bearings is to secure alignment and save expense in machine fitting, not to secure a good surface or material, because any one must admit that the same material hammered in and bored makes a better bearing, but this aside, we need only look at common practice to see the true place of cast bearings.

Machine tool makers, who attempt to do good work, do not use such bearings, unless for rough purposes, such as for countershafts and the like, and some of the best makers of machine tools do not make cast bearings at all, employing cast iron where the purposes do not demand a finer and better metal. We have never seen a cast bearing from the works of Messrs. William Sellers & Co., of Phila-

delphia, and we think a number of other leading establishments have similar rules in their works.

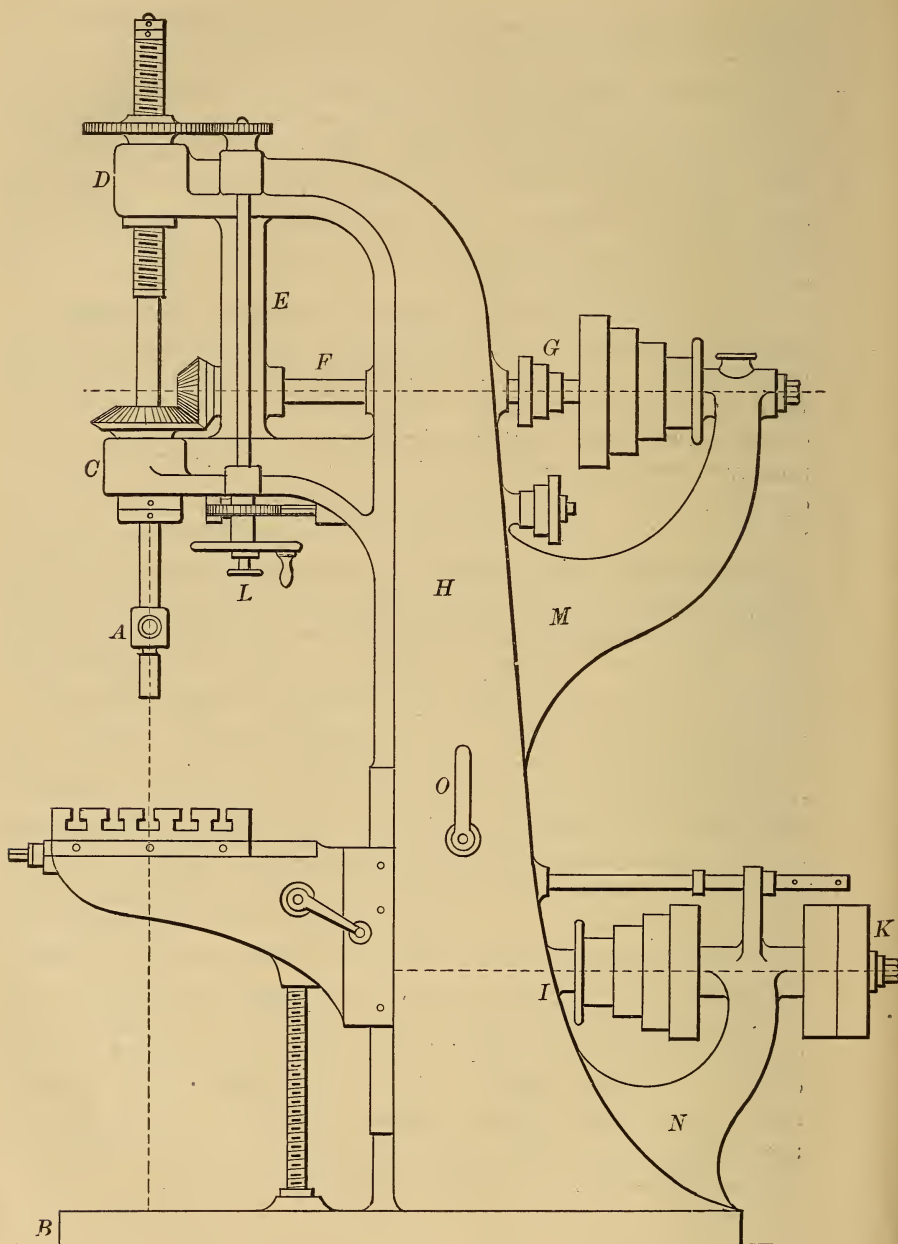
In Europe, where most of the wood-working machines are made with the same care and precision that metal-working machines are, cast bearings would be out of place. They are apt to be loose, wear out rapidly, and it is seldom that such a thing is seen or heard of. Such alloys are employed, as in marine work, and have been for a long time past, but the metal is not cast around shafts to secure alignment, and never will be.

In agricultural implements, subject to deflection and rough use, cast bearings do very well, also for swivel bearings for line shafts or counter-shafts when a fit is not intended or required, also in wood-working machines with light bolted up frames, except for main spindles that have to be maintained in position by avoiding wear. Some makers of planing machines use hard brass for the top or main cylinder journals, the fact being, that whenever a really reliable bearing is wanted, it is not "cast," but is fitted, bored and scraped or ground.

At the present time even brass is giving way to phosphor bronze and other harder alloys, and it is common to find specifications calling for such material in bearings subjected to pressure and severe use. Hardness, a different molecular construction, and strength, seem to be the main points. By strength we mean resistance to shocks due to pounding, or in the percussive class of machines.

One thing that has led to an extended use of cast bearings, especially in this country, has been built-up frames, liable to move or spring after the shafts and spindles were in place. This method of construction is fast disappearing, and when solid frames cast in one piece are more common, the bearings will be more often bored and fitted with bushes or "set in" boxes, because with proper boring appliances the alignment of shafts is secured nearly as cheap in this manner as by setting them and then casting the bearings.

With very careful fitting and perfect rigidity, or maintainance of alignment, there is no material better than cast iron for bearings, even of high-speed spindles. In the Springfield U. S. Armory may be seen such spindles mounted in cast iron, that are often untouched for years, but the danger is that in case of cutting, for want of lubrication, the spindles are injured or spoiled.



EXAMPLE OF MACHINE DESIGN.

THE GRACE OF MACHINE DESIGN.

In considering the form of machine frames, everyone experienced in the constructive arts must admit a kind of intuition, quite aside from analysis, that renders the design pleasing or otherwise.

The problem is divided into two phases, the adaptation to strains, functions and symmetry. The latter may arise out of the former, and does to the eyes of a skilled person, but to those oblivious of strains, uses and contemporary practice, this power of understanding is denied, and we have thus two standpoints from which judgments are made up.

In the case of simple or obvious strains this difference of view is less, as for instance in a girder, beam or post, and in static structures of any kind of which there is wider popular understanding, but in the case of machines, especially those subjected to vibration, concussion and uncertain stress, it requires the greatest talent of a designer to attain an appreciable harmony. To first look at the utilitarian or commercial side of the problem, few suspect the extent to which people are influenced by symmetrical design. Not only the unskilled, but those who are competent to analyze and deal logically with the matter. First impressions, which are the most lasting, arise instantly upon seeing a new machine design. Its symmetry is unconsciously accepted as a measure of the maker's skill, and the functions are taken on faith, safely, too, as a rule, because for some reason not easy to explain, symmetry and adaptation grow up together.

Competent draughtsmen make symmetrical frames, and incompetent men do not. The reasons we need not inquire into; the fact is well known. In some cases, it is true, we find a machine whose functions are good, clothed in uncouth dress, but in such cases the working results have been arrived at tentatively, by the cut and try rule, and designing in the usual sense of that term has not entered into the matter at all.

There being no rules for the designs of machine framing, and perhaps none possible that can become uniform, there is naturally most diversity in the simpler kinds of machines. Among these, and perhaps the best example that can be selected, because the most familiar, are drilling machines for metal. These do not in common drilling include the functions of tool support and guidance. They merely revolve drills and press them forward, the cutting edges receiving support from the points, and guidance is derived from

lateral bearing at the sides or from the twisted stems. So that revolution and feed are the main points, and indeed the only functions to provide for, except some kind of sufficient support for the work.

In this respect drilling machines are unlike all other metal cutting tools, because in all kinds of free cutting, as it may be called, the tools and their supports, also the frames, have to withstand the strain of cutting usually transverse to the stem of the tools. If in a drilling machine, boring or milling is done by means of projecting tools supported wholly by the spindle, especially when cutting at one side, then the operation becomes analogous to that of other machine tools. There are strains set up between the spindle bearings and the table that require complete rigidity the same as in turning and planing, but in plain drilling there are no such strains, and the designer has a clear field for vagaries of designs for the frames.

The drawing on page 108, taken from *A Manual of Machine Construction*, is a composite one, made up from a number of selected designs, modified from all, and will serve here for an illustration.

This drawing with an analysis of the design were published in No. 3 of this Journal for October, 1888. It is reproduced here as the best example at hand to explain the subject under discussion.

There can be no clear definition given respecting the shape and contour of the various parts of the framing here shown. These may of course be analyzed in respect to strains, accessibility, convenience, facilities for constructing, cost, and so on, but the whole design, in so far as harmony and the impression it conveys, can be spoiled by a few changes in the contour lines.

The converse of this design if presented graphically would no doubt be construed as a disparagement of some maker's designs, and must for that reason be omitted. It can be imagined, however, with its parts all bolted on, part of them cored and part of rib section, straggling, uncouth, and weak in respect to strains.

There is in the case of designs for metal working machines one element, or function it may be called, that is obscure, if not inexplicable altogether. It has been called the "anvil principle," or "massiveness," the effect of weight in tools and machines that are subjected to constant strain, such as turning, planing, drilling and milling machines. That weight and sections play an important part, every experienced mechanic will admit, but the "reason," as before remarked, is not known. It may be the absorption of inappreciable vibration and deflection. The edge of a cutting tool is sensitive to the slightest influences.

LITERATURE.

The Stetefeldt Furnace.

Mr. C. A. Stetefeldt, the well-known mining engineer, sends us copies of two papers presented by him at the Pittsburg meeting of the American Institute of Mining Engineers in 1892, on the Marsac Refinery, and a paper on the Stetefeldt Furnace, read at the Baltimore meeting, 1894.

The last named paper cannot be charged with any kind of commercial nature, in as much as the patents on the Stetefeldt furnace must have long ago expired, the first furnace having been erected in 1869 at Reno, Nevada. The purpose of the paper being, as the author says, to remove some misconceptions in respect to its functions.

These papers, all of them, indicate the exact nature of the author's practice, and the methodical methods of investigation, that has enabled him to add a great deal to the arts of metallurgy in this country.

The subjects treated are not understandable by the popular reader, and to metallurgists a notice, such as could be written here, will have no value, so our office is narrowed down to a mere reference, and saying that copies of these papers can be had from the author by addressing him at Oakland, Cal.

Consular Reports, No. 159.

DECEMBER 1893.

The present is an unique number, having 150 pages devoted to the "poultry interest," made up of reports from Consular officers in all parts of the world. The subject is not without general interest. The poultry business is an universal one it seems, and in this country one of enormous volume, representing, including eggs and the meat of fowls, perhaps one tenth of the food product.

One thing is apparent throughout these reports, that poultry raising is conducted on the principal of "automatic evolution," the survival of the fittest. France, where alone the raising of poultry is an organized industry, is not included. The exportation of eggs from France to Great Britain equals \$7,000,000 annually, and the total importa-

tions there reach \$18,000,000 to \$20,000,000 yearly, which, added to the home product, must be half as much, the egg trade and consumption will reach \$30,000,000 annually.

Other sections of this number of the Consular Reports were noticed in our January issue.

Report of the Chief Constructor, U. S. N.

FOR THE YEAR ENDING JUNE, 1893.

Chief Constructor Hichborn has submitted his annual report in a terse documentary form, as becomes an engineer's work, with estimates for the succeeding fiscal year, and tabulated facts respecting the past year.

Eight new naval vessels were launched, aggregating a displacement of 47,916 tons, with 93,700 horse power. These include the *Columbia*, *Marblehead*, *Olympia*, *Cincinnati*, *Katahdin*, *Indiana*, *Massachusetts*, *Minneapolis*.

Specifications are given for three new gun boats, Nos. 7, 8 and 9, which it seems must include nearly all the elements of a cruiser.

We expected in Chief Constructor's report to find his views respecting the protection of ships from fouling by copper sheathing, but the subject is not taken up. It is well known that he has devoted a good deal of study to this matter, but no doubt without such conclusions as would warrant presentation in an official report.

His tribute to the former Chief Constructor, Theodore D. Wilson, is graceful and deserved also, and contains the main facts in his ten years of service. It is as follows:

"In concluding his first report, the Chief Constructor considers it not only a pleasure but a duty to make special mention of the magnificent work accomplished by his predecessor during the decade in which he so ably and skillfully administered the affairs of this Bureau.

At the beginning of the administration of the late Chief of the Bureau of Construction and Repair, the Navy consisted of a comparatively small number of obsolete wooden steam and sailing vessels, and half a dozen small iron gun boats. Since that time there have been added to the Navy 45 vessels, aggregating 173,000 tons displacement, and costing for hulls and machinery alone more than \$52,000,000. These vessels embrace

almost every variety of type of modern vessels of war, and the excellence of their design and construction has been the subject of most pronounced commendation by naval architects who stand at the head of their profession in the principal maritime countries of Europe.

The responsibility involved in the design and construction of such vessels, rendered even more difficult in its earlier stages by the comparatively undeveloped state of steel making and shipbuilding in this country, was great indeed, and no words of praise from his successor can add to the professional renown of one who has accomplished so successfully the great task of designing and building a navy which will ever be a monument to the skill, fidelity, and zeal of the late Chief of the Bureau of Construction and Repair.

Transactions of the American Institute of Electrical Engineers.

NOVEMBER, 1893.

This bulletin of proceedings contains as its leading paper what will be to most readers a very remarkable paper, by Dr. W. J. Morton, entitled "A Brief Glance at Electricity in Medicine."

The importance of this paper is far from indicated in its title, which, as is too common at this day, is faulty and inexact. The subject matter is not a "glance," but a careful essay by a physician who is also an electrician in a wide construction of that term. His paper of 47 pages is not brief certainly, and another criticism we make with some doubt is the employment of the term medicine. It conveys the true idea in a popular sense, but we think hardly in a technical sense.

The Committee on Publication append a note to explain that this paper is published "by the order of the Council," a precaution that will be understood when one considers the attempts that have been made to palm off electrical treatment as a cure all for human ailments, but this precaution seems to be unnecessary in the present case.

We have gone on speaking of Dr. Morton's essay without explaining, as should have been done at once, that we are wholly unable to review it in any technical way, and must only confess astonishment at how much is done in electro therapeutics. Since 1752, when Benjamin Franklin treated people for paralysis, it seems this subject has been consecutively followed by learned and responsible physicians, and is now, as Dr. Morton shows, a science.

In the first section of his paper he says:

"Electricity presents itself to physicians for medical use in three conventional modalities, termed respectively: galvanism, faradism and franklinism. The electrical engineer knows no such terms; to him electricity differs mainly in volts and amperes. And, practically, we also work upon the same lines. But time-honored uses and convenience justify us, I think, in retaining for the present our crude classification, since our apparatus consists almost entirely of voltaic cells, volta induction coils and electro-static machines."

In his conclusions the author summed up in a learned manner the possibilities of electrical influences on the system. We quote two paragraphs:

"The law of life is motion—light, heat, chemical affinity, all are motion; possibly material matter itself is either in motion—the processes of life are chemical processes—the resultant energy developed is the mechanical force displayed by our muscles—the neural impulses conducted by our nerves, and the action of what we call our mind. Muscles, nerves and brain are but organic foci for the development of these energies by physical processes.

Electricity, judiciously employed, promotes the activity of the physical processes underlying life and health. It may even constitute the motive power which drives the machinery of life. Be that as it may, we know that we can alter the running of the vital machine for weal or for woe by intelligently turning an electric current in upon it."

Other proceedings at the October meeting consisted mainly in a discussion of previous papers.

The *Engineering* and *Cassier's* magazines for January, are sumptuous editions, containing a large number of plates representing views in the Chicago Exhibition and of exhibits there. Foreign serials come in gorgeous Christmas dress, all reminding one of the wonderful resources of the printer's art that have come up in a decade past. By turning to an illustrated magazine of twelve years ago it may be seen that the methods have all changed in that time, not only changed and improved but so much cheapened as to permit profusion in illustration. By improved is meant true to nature. Steel and wood engraving must, in this respect, depend on a draughtsman's and engraver's skill, the photo-plate comes more within the printer's realm. He has to produce the shades and tints by his art.

LOCAL NOTES.

The Technical Society of the Pacific Coast met on the 6th of January at their rooms, 819 Market Street. Mr. E. H. Merrill was elected a member of the Society, and the nominating committee presented the following names as officers for the present year :

President, C. E. Grunsky ; Vice-President, G. W. Dickie ; Secretary, Otto von Geldern ; Treasurer, W. C. Ralston, and for the Board of Directors, Frank Soulé, W. F. C. Hasson, Geo. E. Dow, Henry S. Wood, and J. C. H. Stut.

A paper by Chas. T. Hoffmann on "The Red Point Drift Gravel Mine" was read by Ross E. Browne, E. M. This paper is one of much interest and value, showing the facts in a very successful management, with various suggestive points of a practical nature. The want of space this month prevents us from presenting the main part of this paper to our readers, but it is hoped we can do so in a future issue.

The *City of Pekin* came into this port on Jan 13th with her deck houses, combings and other spar deck furniture smashed and "brought away" by a huge wave that went over her on the outward trip. The management of the ship was undoubtedly all that could be done, as her safety proves, and it is lucky that things are no worse, but the thing to be pointed out is the character of this deck work on the *Pekin*. We were on her during construction, about 18 years ago, and were amazed to see hatch combings, deck houses, and so on, made of "soft pine wood," the bulkheads painted and "walnut grained," but all of what is called in the Eastern States "soft pine." Such work will naturally be carried away if a heavy sea goes over, and should not be permitted, neither should any deck work be fastened down with angle irons. Nothing but hard wood will stand in such a place, and even that is doubtful. Deck houses of iron riveted down all around is what is required.

The deplorable accident on the North Pacific Coast Railway at Austin Creek, on the 15th of last month, shows the treacherous nature of pile foundations in Coast streams. These all flow over fluvial deposits of uncertain depth and uncertain nature, and the

eddies caused by the substructure, bore down and undermine earth supports in a surprising manner. The torrential streams flowing south and west out of the red wood basin of the Santa Cruz Mountains burrow out holes ten to fifteen feet deep during a single freshet. The accident at Austin Creek, about eighty miles from San Francisco, occurred to a reconnoitering engine sent out after a storm to examine and test the line in advance of the regular trains. The engine with eight persons passed to south over the bridge in safety, and then returned as far as Austin Creek in the redwood forest. The conductor went over the bridge on foot, and on looking back saw the superstructure and engine, with its crew, go down into the raging waters twenty feet deep. Not one escaped.

In preparing the grounds and buildings for the Midwinter Fair the sand has been a kindly factor in the case. It was cut, carved, excavated, leveled or embanked, as required, at a small expense, and did not work up into mire when wet. It has saved at least ten per cent. over what the whole work would have cost on a clay soil in the winter, if possible at all on such ground. It will be a curious thing to point out to Eastern visitors that the whole of the earth under the exhibition has been at some time in the air, blown over from the coast, and flowing like water when active. Not only is this drift sand easy to shape and work, but when wet or in water is as solid as stone. Some years ago, when concerned in the erection of a brick building in this City, we remonstrated with the architect for laying foundation courses on quicksand. He laid a brick on the sand where it was covered with water, handed us a rammer, and requested that the brick be "driven down." One blow settled the matter, the brick could not be settled any more than if it had been on a wall.

Farther, in respect to this matter of drift sand. We once had occasion to sink a caisson of iron, 48 inches diameter, down about 12 feet in the sand, after cutting through a concrete floor in a basement on First Street. When half way down too much pressure was applied, and the caisson, which was too weak, collapsed, and was drawn out. The sand ran in from all sides, filling up the hole, forming a circular concavity beneath the floor, which broke down and came nearly extending to the walls, and in that case would have

ruined the building. So long as there can be no lateral flow, and the sand is beneath water, it is immovable, and will bear an immense weight, but has no stability when not confined. The buildings of San Francisco, most of them, rest on this sand, commonly on platforms of timber laid on the sand, and we imagine that, except where erected on piles in "made ground," no city in this country is more free from buildings injured by settling strains than San Francisco.

Still farther in respect to foundations. Common wood dwellings erected where there is no frost, and that means in all districts near the coast, do not require any but surface foundation, which can be made as follows on almost any kind of soil. Cut a ditch about 8 inches deep and 18 inches wide, fill with broken stone, ram the stone, and cover with a coat of mortar, and then build on top courses of brick high enough to raise the ground sills above moisture. Such a foundation is cheap, and will remain a lifetime if not disturbed by excavations. Settling, such as takes place, will be uniform and unnoticeable. Mud sills of red wood are frequently used for cheap houses, and when of heavy heart wood will last a dozen years, perhaps twenty, but they cost nearly as much as the plan above described, and are inferior in every way.

Mr. E. A. Rix, of 220 California Street, in this City, has sent for examination a sample of "raw-hide packing" for hydraulic purposes that seems to be a very important invention or discovery. It is soft, pliable, and, as everyone knows, possesses an endurance under sliding contact and pressure beyond any other substance known in the arts. Why it has never been employed for packing is hard to understand. In various other cases raw-hide has been employed for ages, and, as it happens, under conditions analogous to those that exist in the case of packing around pump pistons, or other moving hydraulic joints. Cup leathers have, to a great extent, given way to fibrous packing, that is cheaper and better. In this City the hydraulic plant at the Palace Hotel came near failing by reason of cup leathers, which almost by accident were substituted by common hemp packing that has caused no trouble for 18 years past. The raw-hide packing has even greater merits, wears out in place, and need not be removed, only new rings added. It has every appearance of being just what is required, and has, it seems, already spread to a wide use for cold-water glands and joints.

In a supplement to the Political Code of California, relating to County Government, one may see some of the results of having, in this country, from twenty to thirty thousand people "making laws." The counties are divided into "fifty-three classes," with a separate law for each class, the difference relating mainly to the salaries of officers, which seem to be based on population, and hence definable in a single paragraph, or even in a simple arithmetical proposition. The act was passed in March, 1891, contains 273 sections, and occupies 423 pages of the pocket edition of the California Code, published in the present year. The act is amendatory, hence is not all, nor nearly all. Of all things earthly nothing seems to progress so little as government. It is sometimes called a science, but it lacks all features of science, and has always warranted Voltaire's assertion that "the only useful legislation was the repeal of bad laws."

The *Irrigation Age*, for January, comes to hand in a new dress as to form, type, paper, and make-up, 8×10 inches in size, and wonderfully improved in every way. The interest represented by this Journal is, as the President once remarked, "not a theory but a condition," and the wonder is not that the irrigation of arid lands is being considered, but that with precedent far beyond a historic period, little or nothing has been done in this country. Even the aboriginies, whom we call savage, have left extensive traces of their works in the arid regions, full of suggestion and fact, and nothing but the abundance this far of naturally-watered land can be plead as an excuse for the present circumstances. One teature of irrigation of great value is that such works furnish employment for capital that would otherwise be forced into railways and branches of manufacture already extended far beyond the economical requirements of the country.

The Fulton Engineering and Shipbuilding Works, some time ago had a serious case of repairing on the steamer *Bawnmore*, that had been on the rocks and was smashed up in a thorough manner. The stern post, 38 feet long, of steel, 8×10 inches, had to be taken out and welded in ten places, and then shaped so as to fit back into the vessel, a feat that seems almost impossible with so large a piece. The rudder post, 6×8 inches, had also to be welded and refitted. Sixty or more plates were cut out and new ones put in, so the work was very like building a new ship. The new Sausalito ferry boat is under

way at the works now. This vessel will be 255 feet long ; beam of hull, $38\frac{1}{2}$ feet ; over the guards, 60 feet ; depth of hold, 17 feet ; draught, 5 feet 6 inches. The machinery will be of the plain beam and paddle wheel type with adaptation to the higher pressures of the present time.

There is one feature of the Midwinter Fair that will astonish our Eastern friends—the cost of subsistence. On the 6th of last month after a two hours' tramp through the grounds, ending at 2 P. M., we turned into a respectable-looking restaurant outside the gates, ordered coffee, a dish of well-cooked meat, potatoes, a dish of apple sauce, which were served with the usual liberal accompaniments of bread, butter and the rest, also a plate of pastry, and on finishing this very decent meal, tendered the host a \$5.00 piece in payment. He began counting out change, and kept on up to \$4.75, bowed and pushed it across the counter. The same viands would have cost in Chicago 65 to 75 cents previous to the Fair, what then we do not know. The profits made by "victualers" of the popular class in San Francisco are not great, and there is no meanness about it—no air of "catch them for one time." There is plenty of swindling here, no doubt, but it is not of the "alimentary" kind.

COMMENTS.

There has been a good deal of fault found with the proposed assessment of customs tax *ad valorem*, or according to value, and a person is constrained to ask by what other method can such a tax be assessed fairly. Specific duties are for deception, and a ruse to blind people in respect to the amount. For example, some kinds of heavy woolen cloth under the present duty is assessed at $49\frac{1}{2}$ cents a pound specific and 60 per cent. on value. This makes a duty of 303 per cent. on this cloth; 243 per cent. of which is hid in the specific-duty clause. The cloth referred to is such as is made into women's cloaks, the coarser kind that the poor people buy and use. Whatever is done there should be fair understanding of these matters, and who can judge of what a specific duty is unless familiar with the price and nature of the articles taxed? Then again the question arises what is a duty of 303 per cent., or even one of 100 per cent. for? If it is to prohibit, why not say so and be done with it?

Various journals come now filled with warnings to working people that a reduction of tariff customs will lower wages. None of these warnings are from the working people, but from their employers, who always, on such occasions, become very anxious to "keep up" wages. This concern about wages comes from the wrong side, and requires no serious consideration. Wages are more likely to go up than down with cheaper material. Both cannot be dear at the same time, and wages will remain quite the same for a given amount of work irrespective of tariffs, but the most inconsistent of all is a clamor in certain journals for a high tariff on certain things produced in their districts. The fact is that nearly all those who, in any way, favor interference with prices by law want a tariff on what they sell and free trade for what they buy. That is the spirit that lies at the bottom of the whole; it is mainly a struggle for personal advantage.

The State of South Carolina has adopted not only the Gothenburg system of selling spirits, but has gone further, and this far has fared well. The traffic, with its profits and responsibilities, is taken over by the State, and conducted by proper officers appointed for that purpose. The monopoly is much more complete than that of the French Government over the tobacco trade; is indeed a total usurpation of all rights. The ethics of the matter is easily disposed of. Any means are excusable, and no rights of any kind should be acknowledged in any pursuit like barkeeping as it is commonly conducted in this country. The only warrant should be a majority of votes in any State to impose any regulation whatever over this traffic. Laws to regulate the trade in the hands of private people act like the proverbial "water on a duck's back." Not even the hours of the traffic can be thus restricted, prohibition is impossible, and the only way seems to be for the government to assume the whole business, and conduct it in a decent and safe manner, or as nearly that way as possible.

There has been a kind of business convention in Denver, Col., where it was claimed by some of the sane citizens that the city was at the present time the most prosperous one between the oceans, and the State the most prosperous in the Union by comparison, and the first to show signs of business revival. This should be a lesson to "calamity howlers" from that section who, only three months ago, declared that Colorado was ruined by the repeal of the

Sherman Act. We do not in this remark include the sanguinary Governor of the State of Colorado. There is no hope of his learning or profiting by lessons of any kind, but there is a hint to some people on this Coast, who discover that the eastern end of the country has neither honesty nor judgment, and that the administration of the Government is all wrong. The newspaper noise of the time, the only literature that the "howling" element of community reads, will soon be a less power in the land, or else the "land" will end in lunacy or something worse.

The French Government has always, more than any other, lent aid in the encouragement of industry and invention, and now has a series of standing prizes, a dozen or more, open to the world for improvements, such as steam economy, a substitute for India rubber in one or more uses. The invention "most useful" among those offered between now and 1898 will receive a special prize of \$2,280, and a similar prize will be offered in periods of three years. The Henry Giffard prize, a permanent one, awarded every six years, is \$1,140 for inventions signally serviceable to French industry. The smaller awards made yearly, run from \$300 to \$500 for specified inventions or improvements. As these prizes are open to the people of this country we recommend our readers who are given to ingenious invention, to procure definite information in respect to the prizes. Such information can, no doubt, be obtained from French consular officers here.

A special commissioner of the *Engineer*, London, made a serious blunder in a report of his on the Buckeye Company's steam engines, shown at Chicago and in general, stating that the valve movements are incorrectly described, and that the engines consumed from $23\frac{1}{2}$ to 35 pounds of steam per indicated horse power per hour. This we consider the worst "break" made for years. It would have been interesting to see our old friends Mr. Sharp, the president, and Mr. Thompson, the engineer, of the Buckeye Company, after they had read this report. Mr. Sharp, by common concession, is one of the greatest indicator experts in this country, and has been for twenty years past an authority on engine economy. Mr. Thompson is certainly one of the highest authorities in this or any other country in general steam engineering and valve movements, and we venture to claim that the staff of the Buckeye Engine Company cannot be

matched by that of any similar establishment in Great Britain. Mr. Dredge, of *Engineering*, who carefully examined the practice of the Buckeye Company in 1876, formed very different conclusions to those above given, by the *Engineer's* commissioner.

There was great merriment over General Hancock's celebrated postulate that "the tariff is a local question." It had a good deal to do with his defeat as a presidential candidate, and, while he was no doubt fairly charged with making an "Irish bull," the literal truth of his words is now being verified in this country. The New England papers come almost in mourning, and filled up with all kinds of arguments, new and old and varied, in favor of import taxes on nearly all things except coal and iron, amost the only articles that "local" interests there demand to be free from tax. The tariff is a local question verily. One might wonder what New England would do if the coal and iron there were to be procured under the circumstances of this Coast, where more than four fifths of the whole import coal tax is collected, and where the price of coal is twice as much as in New England. There is not much said here, although our iron industries are on the point of being extinguished by the prices of coal and crude iron.

ENGINEERING NOTES.

Late Chief Constructor of the U. S. Navy, Theodore D. Wilson, read a paper at the New York meeting of the American Society of Naval Architects and Marine Engineers, on "The Steel Ships of the U. S. Navy," a theme he was qualified to treat upon, because nearly the whole Navy coming under this head, was built under his administration of ten years. One interesting feature of the paper is a table showing the consumption of coal by the *Charleston*, at various speeds. Some of the quantities are as follows. The coal per hour is for the main engines, or propulsion only.

Speed in knots per hour ..	4	6	8	10	12	14	16	18
Pounds of coal per H. P. . .	4	325	2.8	2.5	2.3	2.1	1.9	2.5
Pounds of coal per hour . . .	484	875	1,456	2,400	3,933	5,932	8,303	15,300

The consumption at 18 knots seems anomolous, when compared with other speeds. At 15 knots it was two pounds per horse power per hour, and the lowest in the scale. By comparing the first and

third lines it will be seen that the increment of speed is two miles in each case, the square of this is four, and the increase of fuel is approximately in this proportion, that is, the increase of fuel consumed is as the square of the speed. The auxiliary engines consumed six pounds of coal per horse power per hour.

The new torpedo-boat catcher, the *Havock*, constructed by Messrs. Yarrow & Co., of London, for the British Admiralty, is a wonder in her way. The vessel is 180 feet long, 18 feet 6 inches beam, and draught of 6 feet. In this space is crowded 3,400 horse power that drove the vessel 26.78 knots, or close to 30 land miles an hour, in a rough sea for a three hours' run. There are 5,000 feet of heating surface and 80 square feet of grate surface, quite enough for an average ocean steamer. The most striking thing, however, in the trials of the *Havock* was not her fast speed but her slow one. With her bunkers full, that is with a full load, 400 pounds of coal drove her at 10 knots or 11.5 miles an hour, and 11 knots called for only 550 pounds of coal. At this rate the *Havock* can steam 3,500 miles with the coal that her bunkers contain. What the next move will be in naval schemes is hard to foresee. Schicau, in Germany, has built some torpedo boats of nearly the same speed, but most of those in use would be quickly caught by the *Havock*.

There is strong probability that we are, in this country, at the beginning of wrought iron wheels for railway service. The results hitherto attained with cast-iron wheels for both drivers and trucks would never have been imagined, and was possible only because of a high grade of iron, careful processes of manufacture, and a long experience. The expense of forging implements, and a backward state of that art until recently in this country, has caused a wide use of cast-iron parts where malleable iron should be used, for engine cranks, as one example. All the circumstances of use, except that of a hard surface, point to strong malleable metal for car wheels and the driving wheels of locomotives. Such material will, no doubt, be employed in the near future. At the Boies Wheel Co., of Scranton, Pa., wrought-iron wheels are made of the plate form, without welds, stamped out, it may be called, and the manufacture seems to be quite successful. Powerful implements are being added at this time.

Mr. A. D. Pentz, in the *Engineering Magazine*, says planers driven by friction clutches have not been perfected. The "planers" in our region are driven by the foremen usually, but if planing machines are meant we think there is a mistake in the statement, because such machines are driven by the only really durable and successful friction clutches ever invented, namely, a strap or band of leather around smooth pulleys. Considered as a friction clutch, or starting and stopping device for machinery, shifting bands are as nearly perfect as anything we can hope to attain, and whenever such bands can be narrow enough to be easily deflected edgewise, and can be driven at high speed, no other kind of friction apparatus is required, especially for a planing machine that with proper shifting gearing will reverse within a quarter, or even an eighth of an inch. As a rule, leather and polished iron wherever combined for friction purposes give good and durable results.

There are no losses by friction in well-constructed bearings that warrant the use of rollers or balls. In the last edition of *Molesworth's Engineers' Pocketbook* (1893) will be found formulæ and tables taken from late experiments of Mr. Tower, of London, that will show how narrow a margin there is left for rolling bearings, supposing even that these are frictionless. The coefficient of frictional resistance in terms of weight or pressure falls to .01 per cent. with well-lubricated bearings, and is, we imagine, not more than .02 per cent. in any case of good fitting with steel or iron on standard bearing alloys, so that granting all that can be claimed, and waiving the increased liability to wear and derangement, there is no commercial reason for roller or ball bearings unless it be in hand or foot-propelled machines where human energy instead of steam or water power is to be saved.

The future of compound locomotives is by no means assured. The economics of new inventions are often lost sight of in the interest that attaches to technical problems, also are taken for granted by analogies that prove deceptive. The Royal Blue train, a fast express, one on the New Jersey Central Railway, that was formerly hauled by compound locomotives, has now simple engines. The reasons have not been made public, and there are other cases of the kind. Results must be arrived at tentatively or by survival. There are, it is true, certain logical rules applicable to new things of the

kind that will generally give a clue to final results, but such rules are ignored in the heat of discovery. One of these rules is that in high-speed machinery of any kind, inaccessible when in motion, the addition of any detail whatever is undesirable and means a loss, especially when such detail calls for new and more extended skill on the part of attendants. Compounding calls for both these things, besides does not seem to be directed to the principal fault in locomotives, or the impediments to speed. These are capacity to generate more steam, and means to apply it. Compounding serves the first object, and hinders the second, but what the end will be, some years of added experience must determine.

Among the many inquiries that come to the editor, the most frequent are those relating to the transmission of power of machine bands or belts. The reason that this, or any other subject, causes such inquiry is because the rules and data given out are imperfect or impossible, most commonly both. So it is with any rule for determining how much power belts will transmit. It depends on circumstances, and the circumstances permit variation as one to two between the least and most favorable conditions. There can be no rule of any value that does not include tension, which is continually varying, and hardly ever known, so the whole is guess work at best. The coefficient of friction, or the driving power, follows the tension very nearly if a constant area of contact is maintained. The latest reported experiments made at Concord, N. H., by Mr. Samuel Webber, show that with a strain of 50 pounds per inch it requires about 75 square feet per minute of belt surface, or 900 feet per minute of each inch of width, to transmit one horse power. The tests were made with single, double, perforated, and link belts, 6 inches wide, on pulleys 30 inches diameter, and show only one half of the efficiency that is sometimes assumed.

The Laval steam turbine is the only one that this name properly applies to, or rather is the only one that bears an exact analogy to turbine water wheels. The reason of this is that other steam wheels or engines of this class provide for expansion, but Dr. Laval, who is the inventor of the centrifugal cream separators, has taken another and quite different course with his turbine engines. In his method the steam, while in full velocity and under full force, is suddenly

expanded down to atmospheric pressure, and its volume correspondingly increased, just as it is applied on the vanes of the wheel. The principle, or mode of operating, bears some analogy to the steam injector. In this instrument the steam, while flowing at its full velocity as steam, is suddenly condensed, and the water goes on with an impetus due to the steam velocity, and thus overpowers the static pressure in the boiler, and drives not only the water condensed but a large volume besides back into the boiler.

As there will be constructed in future a great many retaining dams in the various irrigating schemes along this Coast, and as these dams will be, as a rule, much higher, and consequently more dangerous than in other parts of the world, we desire to call attention to a late paper on this subject by Mr. Clerke, a member of the Institute of Civil Engineers, London, that has caused a good deal of interest, and is a summing up of present knowledge on this subject. The author was the engineer of the great Tansa dam, and in that work brought to bear the most advanced data available. The discussion, which was largely devoted to dam sections, included the views of engineers of many countries, and, on the whole, this paper and its discussion may be regarded as the latest views on a very important, and not very well understood branch of engineering work. The Council of the Institute have invited written communication supplementary to the paper of Mr. Clerke and the oral discussion, and it is hoped that some of the engineers on this Coast, and we have a number who are able to do so, will send communications to the Institution of Civil Engineers, Great George Street, Westminster, London.

A French Engineer in a late paper describes an ideal hoisting winch, saying it should be powerful, noiseless, occupy but little space, run at high speed, require no repairing, and be managed by a common laborer, with other characteristics of the perfect kind, and winds up with the statement that he had designed such a hoist with all these good qualities, and it is made by a certain firm. This is pretty good advertising, and, no doubt, represents the author's ideas of the matter, but we think the machinery would fail to fill a number of the conditions named. At least here, in California, where these mine hoists have been studied to an exhaustive point, no one has ever thought of making such extravagant claims for them, even in chromatic advertising circulars.

As mentioned in another note Mr. Nikola Tesla has suggested a new method of applying the force of steam directly to electrical generating apparatus by reciprocal instead of rotative motion, thus dispensing with connecting rods, shafts, and fly wheels, and in remarking upon this matter recently told an anecdote respecting the advice of a man who came to him and said : " You have done good work on electricity, stick to it. If you meddle with steam engines you will fail." The man was right. Mr. Tesla starts out with admitting the failure of a stiff spring of tempered steel deflected each way. No mechanic of experience would have made such a thing, but even if the range of a piston can be definitely controlled so as to not cause loss by clearance, how is the motion of a reciprocating weight to be regulated without a crank ? The function of a crank is indispensable in rapid reciprocal motion, and if not rapid in movement the machinery must be expensive in a commercial sense, or inefficient in proportion to weight.

A contemporary occupies nearly a long column of brevier to describe a " double-acting Cornish pump," which one finds out, after reading one half the column, to be a bucket-plunger pump of the common type, and quite understood from that name alone. The reduced weight of pump rods, and so on, are all included in the name, but the point we wish to make is that for average lifts there are certainly advantages in favor of the bucket-plunger system. It does away with one set of valves, most of the air chamber, and is by far a more simple arrangement than the double-acting " jack head," or Cornish plunger types. Within their limits the most complete pumps in use on this Coast are the irrigating ones employed in tube wells, having a wooden rod in the up-take pipe that displaces on the down stroke one half as much as the bucket raised on the preceding up-stroke. It is of course the same in method as a deep-well pump with a plunger and packing gland at the top, so as to admit of forcing as well as lifting, but the old tube pump, where the water can flow out through a spout, is the most perfect of all.

The fall of the Louisville and Jeffersonville bridge, over the Ohio River between these cities, during its construction, was one of the greatest accidents of this kind that has ever occurred in this country. There were fifty-two men on the structure when it fell, and of these

twenty-one were lost. The Phoenixville Bridge Works were the contractors, and were, no doubt, proceeding on the customary narrow factor of safety allowed for false work and staging. The "traveler," a high tower that precedes and supports the work during erection, was 100 feet high, and about 50 feet wide on its ways. The false work was over 70 feet high, resting on piles driven in 30 feet of water, about 33 feet of their length being unbraced. The accident happened in the middle of December, at a time when such work should not be carried on unless with extra precautions. The engineer of the contractors, Mr. J. S. Deans, has published drawings of the various structures, with an account of the accident, and thinks there was enormous wind stress, a kind of cyclone, that lifted the completed span, 553 feet long, and this may be possible but is not probable. The Phoenix Company is a very responsible one, but in competition are, no doubt, compelled to follow methods that incur danger.

ELECTRICITY.

NOTES.

Some little progress has been made in propelling canal boats by electric motors, and there is no reason why a canal boat cannot be driven by an electric current the same as machinery of any kind can be so driven. The problem lies in other directions. In the first place there is the objection that applies to all canal boats impelled by screws, of causing wash. The same objection applies to speed, and a new method of applying power will not obviate these difficulties. In the case of canals that are employed for coal carriage, or in districts where coal is cheap, the best method is to employ steam engines to drive boats. A motor boat is helpless except when in contact with a line or conductor, and cannot "navigate itself," if, as is commonly the case, there are tide-water journeys to make in addition to the canal voyage. There may be gains by transmitting power to canal boats electrically, but we must confess they are not very clear at this time.

Electric quackery has not spread so much in England as here, and we have heard little of it except in these two countries. The attacks upon it in London have been so vigorous that the chances

are it will disappear in all forms not supported by reputable physicians. The "Harness Company," of London, that made electric belts and other pretended electrical appliances, is being "wound up," as the people there call it, and a Dr. Tibbetts, whose name was given to a recommendation of these electrical appliances, has had his name stricken from the Royal College list of surgeons. Human superstition clings around healing agencies, and the last vestige, if it ever disappear, will no doubt pertain to mysterious agents for curing disease; but there is one good feature in it, people have always been left free to dose themselves according to their fancies, and they have done but little harm to others except by recommendation of nostrums.

The suits brought for infringement of Edison's patent No. 264,642, of Sept. 19, 1882, is likely to cause a good deal of trouble and expense to those who have adopted what he claims to be a direct infringement of his invention. The patent relates to "the combination of two portions of a circuit in a system of electrical distribution, by which uniformity of action of incandescent lamps is secured, etc." One suit on this patent has been decided in favor of the plaintiff, and now two more are entered in the State of New York. Several other Edison suits are in progress, and if he gives the issues personal attention he will soon be qualified as a lawyer in so far as the patent suits at least. Mr. Edison some time ago denounced patents as of no value to him, or rather "costing more than they came to," but notwithstanding these many suits it seems he has not lost all faith. We imagine that without patents he would now be on the Western Union, or some other electric company's staff, at a fair salary.

The latest announcement in electric accumulator batteries comes from Hanau, Germany, and relates to the use of the "finest lead dust" as an active material instead of peroxide of lead. It sounds a good deal like an attempt at novelty to evade existing patents, because the finely comminuted lead would very soon be translated into peroxide. It is claimed that the lead dust is mixed with some medium that permits individual expansion of the particles without interfering with the plates on which the paste or coating is sustained. One would naturally look to Germany as the center of storage discoveries, but this far it seems they have not contributed their share to this puzzling branch of electric science. We, some time ago, suggested

that as no substantial progress had been made in the fundamental principle of the Fauré battery it was time that mechanics took hold of the matter, and put the Fauré battery into better form, so as to resist mechanically the destructive strains on the plates, which just now seems to be a principal impediment.

A society in Holland invites competing plans for the generation of electricity by means of wind mills, the common means of power in that country, and offers a prize of \$150 with a gold medal. The scheme contemplates a paper with drawings, and one inference is that such work must be cheap in the Netherlands, or else that the medal is a large one. The money would not go far in the preparation of plans and descriptions of the kind here. There have been erected in this country a number of these wind plants, one by Mr. Brush, at Cleveland, Ohio, that was said to perform very well. There is a possibility of utilizing wind power in this manner, or in some manner, if the cost of motive power continues in future as it is now. Thus far it must be admitted that scant aid has been gained from either flowing wind or flowing water, that is, from the natural impulse of these elements, mainly because of the low pressures, the engines or devices to utilize these forces grew in size and cost beyond a commercial limit.

Professor Thomson, in an article on the late World's Fair, in the *Engineering Magazine*, on electricity and the exhibits at Chicago, says :

“ The one discordant note in all this great display of genuine scientific and engineering work was found in the fact that in this same temple of science, in Electricity Building itself, naked imposture, quackery in the form of so-called electric belts, hair brushes, insoles, and what not, had obtained a footing and stalked forth unabashed. No words of condemnation can be too strong to be applied to the parasites, who, in the guise of healing and benefaction, succeed in extracting perhaps the last money from the sick and suffering for their worthless trumpery. The fact that such exhibits were found in 1893, holding place alongside of genuine electro-therapeutic appliances of undoubted merit only heightened by contrast the great shame of their presence.”

MINING.

NOTES.

The following is an extract from a circular recently received from Berlin, Germany :

"In all places of the globe, where gold is being or was produced, there are accumulating, or have accumulated, enormous quantities of auriferous matter (sand, clay, quartz) from which the gold is already extracted as much as can be done by the means hitherto employed. These mountains of matter, technically called 'tailings,' were, up to the present, nothing but useless obstructions. Electricity has thoroughly changed this state of things. I have at my disposal a method of extraction by electrolysis, the use of which will make a *Source of Immense Wealth* of these tailings. The gold left in the latter varies very much in quantity. In some instances only traces of it can be found, but on the average the alloy may be calculated to be from 5 to 10 pennyweights (dwts) of gold in a ton of 1,000 kilogr. of tailings."

The circular was submitted to Mr. C. A. Stetefeldt, of this City, metallurgist and mining engineer, and in return received a note, from which we will quote one line: "This is all bosh and nonsense." It is not the custom to notice these things, but as others have had similar circulars the above analysis may be of use.

Mr. Albert Williams, Jun., has, in the December number of the *Engineering Magazine*, a laughable notice of the Denver, Col., Mining Stock Exchange, and the press notices of the operations there under flaming heads of "Advance in Stocks," "Great Amount of Sales." "Total Amount of Transactions for the Day, Fourteen Thousand Shares," with much more of the like. All of this is spoiled by Mr. Williams' statement that the prices ranged from half a cent to four cents a share, and the total of the day's transactions on change, amounted in money, less one sale, to the sum of \$308.25. The excepted sale was a heavy one of 500 shares at \$2.15, which raised the total to \$1,383.25. We were not aware that such nonsense was carried on in Denver, and must modify some previous ideas formed of the stock exchange business there.

The destruction by fire of the hoisting works of the Idaho Maryland mines, at Grass Valley, Cal., on the 9th of last month, came near being a death trap for 75 to 80 men who were in the mine at the time. There was of course no chance of escape by the main shaft, over which the burning works stood, but a warning was sent down the air shaft, and the men, after an hour and a half of dreadful suspense, and when the hoisting works were consumed, ascended 2,000 feet on the ladders in the ventilating shaft, and all came up safe. The loss of the works at this time is most unfortunate. It will throw a large number of men, 200 or more, out of work for two to three months, and will complicate and delay a transfer of the Idaho mine to the Maryland Company, which was being prepared for at the time. The loss will reach \$60,000, on which there was insurance of more than one half. The companies are fortunately able to at once rebuild the works, and began to clear away as soon as things were cool enough to be handled.

MISCELLANEOUS NOTES.

Mr. W. T. Stead, the inventor of the *Review of Reviews*, a journalistic genius who has figured as the center piece in various public matters of a press nature in England, proposes to establish a new daily newspaper on a novel plan. He wants the subscribers to advance the money to found the paper with, and entrust him with the whole matter, money and all, and they would do so without hesitation if they had the confidence in Mr. Stead that he has in himself. We can suggest a much easier solution of this ambition, which is to change the name of his present publication and issue it oftener, because the "daily paper" would be only a re-hash of the *Review of Reviews'* methods, which consist mainly of an appropriation of other people's writings, a high class of "tid bits," interlaced with criticisms late enough to follow public opinion. Mr. Stead is the "boss" literary advertiser of our day, and will, whatever else he may do, gather in sheckels and notoriety.

The death of Dr. Lucius A. Smith, of the Continental Iron Works, Brooklyn, N. Y., removes from among American engineers one of much distinction in several branches. Dr. Smith was edu-

cated at Yale as a medical doctor, but his predilections lay in a different course, and he took up the study and practice of naval architecture and engineering, and so successfully that he became a superintendent of construction for several vessels of the navy, and was the builder of some noted yachts, among them the *Day Dream* and *Phantom*. He was a member of the American Society of Civil Engineers, the Society of Naval Architects and Marine Engineers, as well as other scientific associations, and was the engineer of the Continental Iron Works in their extensive and diversified business. Dr. Smith's funeral was attended by a large number of eminent engineers of the army, navy, and in civil practice, a tribute of respect that indicates the high position he held while living.

Some one with a mind for computation has found out that a bushel of maize will yield four gallons of whisky, which retails when of good quality for \$16.00. Of this the Government gets \$3.00 for taxes; the railways \$1.00 for transportation; the distiller gets \$4.60; the retailer \$7.00; the farmer who raised the grain, 40 cents, and the drinker gets the *delirium tremens*. Supposing this to be correct, and it is evidently something near it, there is a large sized moral in the fact, and a suggestion of following out in the same manner some other kinds of "industrial products" on the same line of analysis.

The hydraulic mattresses employed in building the great Memphis bridge, across the Mississippi River, were 400 feet long and 240 feet wide. These were to prevent scour in the bottom of the river under the pier sites. In each mattress was 1,000 cords of brush and poles, 900 tons of stone, and 10,000 pounds of wire. Such mattresses as these would astonish our friends in Holland, where the art came from. Like Mark Twain's tunnel that was "built on trestles," the Dutch would have to excavate a place in their rivers to sink the mattresses.

Mr. Uriah Dudley, of Broken Hill, South Australia, last summer found occasion to cross the lines of that colony to Silverton, and for fear of accident took along a new suit of clothes that the Silverton authorities valued at £5—16s.—1d. Just how the penny came in Mr. Dudley is not aware, but is more clear upon the subject of a fine of £17—18s.—3d. imposed by a police judge in Silverton for a refusal to pay duty. By this time the suit of clothes had advanced

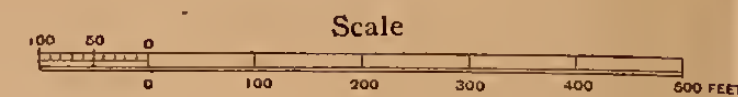
to £25 sterling, and was good enough for the Queen's levee. It is to be hoped that New South Wales will soon set an example to stop the craze in the Australian Colonies to raise revenue on consumption. It is a very poor system for that country, and as an exchange remarks of the Victorian Government, the main business just now is hunting up new things to tax.

A correspondent of the *Engineering and Mining Journal*, with destructive zeal, attacks the venerable theory of coal formation from vegetable matter, much as Luther did the tenets of Rome, and it must be admitted with some success, or consistency at least. The existence of vast beds or pools of mineral oil, the origin of which has called for distinct theories, throws some doubt over the vegetable-coal genesis. It seems that the principal evidence of a vegetable origin of coal is the existence of trees and plants in the seams, but, as the writer above-named claims, this by no means is enough to support so ponderous an assumption any more than the hair in mortar indicates its formation from organic matter. The hitch in the vegetable theory that has caused most doubt, not mentioned, however, in this case, is the mass of vegetable matter, and the abnormal growth to produce it, that is a necessary part of the vegetable hypothesis.

The purchase of French boilers by the British Admiralty is characteristic of methods in that country in two ways ; first, it is the surest way possible, much surer than a tariff or premiums, to bring out the same manufacture at home, and, secondly, shows a system of buying wherever the thing wanted is cheapest and best. Several gun boats, and one 14,000 ton cruiser, are to be supplied with French boilers, and we will request our readers to watch and see the effect, and if it does not lead to the sudden production of a superior quality of water-tube boilers for marine purposes in England. We once knew of an order for iron beams sent from Manchester to a Belgian firm because of a very slight difference in price. The order was given by an old engineering firm, and an iron works in the neighborhood complained that an order should not be sent abroad for so slight a difference. "That," said the buyer, "will be of more profit to you than if I had given you the order. It will teach you to make beams cheaper than the Belgians," and it did. The way to keep orders at home is to excel.

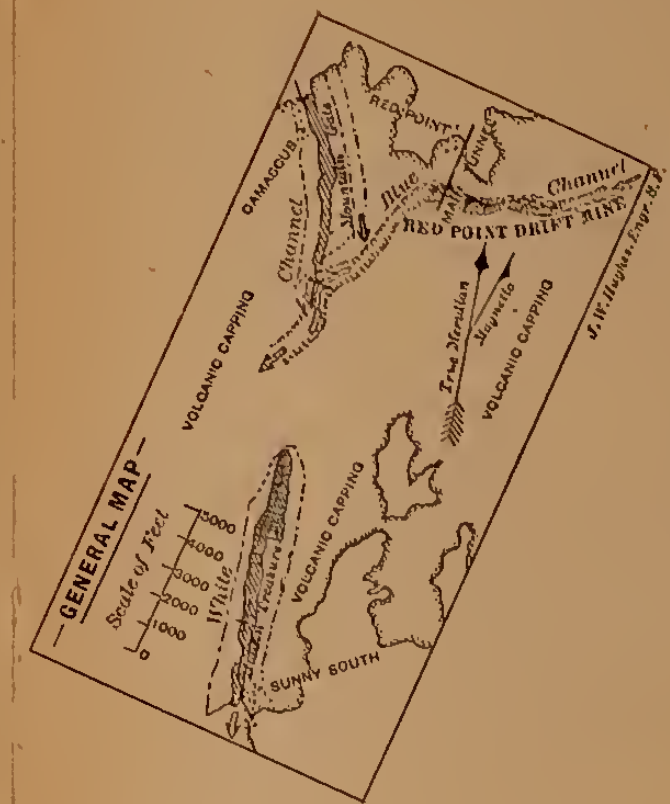
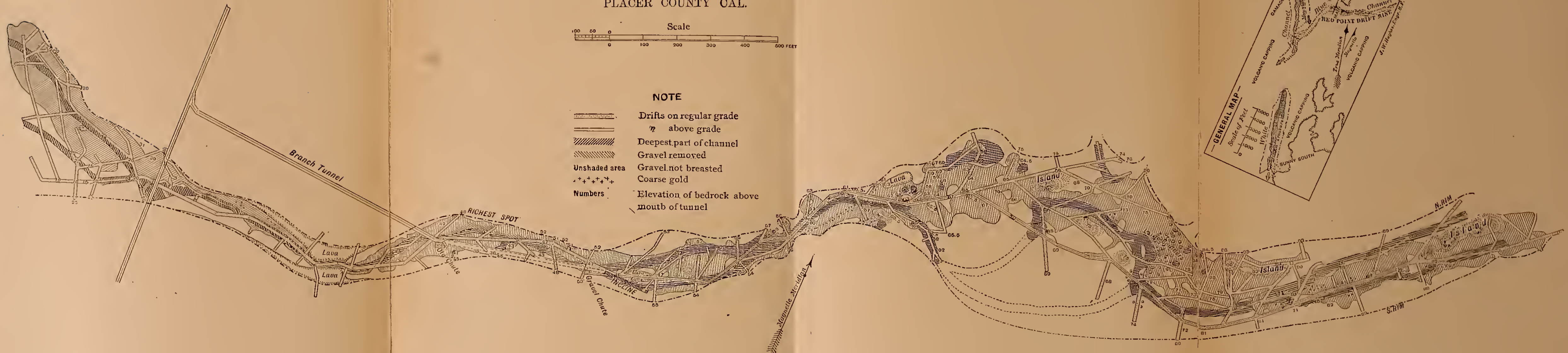
RED POINT DRIFT MINE

PLACER COUNTY CAL.



NOTE

- Drifts on regular grade
- " above grade
- Deepest part of channel
- Gravel removed
- Gravel not breasted
- Coarse gold
- Numbers Elevation of bedrock above mouth of tunnel





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THE RED POINT DRIFT GRAVEL MINE.

BY CHAS. F. HOFFMANN, E. M.



The "Red Point" is a drift mine in one of the ancient lava-capped river channels of the Forest Hill Divide, Placer County, California, located at an elevation of 3,875 feet above sea-level, or 2,000 feet above the North Fork of the American River. It belongs to the Golden River Mining Co., of Paris. The channel is known as a "blue channel," from the color of the gravel.

DISCOVERY.

This channel was first discovered in the Mountain Gate Mine, at Damascus, about a mile and a quarter distant from Red Point. The Mountain Gate was originally located on a channel of white quartz gravel known as the "white channel," which the owners followed in a southerly direction into the hill for a distance of 6,500 feet, where they found it sharply cut off by a flow of lava or volcanic cement. The words "lava" and "volcanic cement" are used as commonly applied by gravel miners. The material in this section is composed of consolidated sediments from a volcanic mud flow, which have been variously described as tufts, tufas, breccias, conglomer-

*A paper read before the Technical Society of the Pacific Coast, Jan. 6th, 1894. Reprinted by permission.

ates, and cements. There is little or no evidence of a molten lava flow in this section, except perhaps on the summit, where the lava is crystalline. The bed rock, with the volcanic cement resting upon it, pitched sharply to the south. After drifting to and fro along the contact, hoping to find the continuation of the white channel, the bed rock was followed down on its pitch, and the gold found to continue as far as the exploration extended. A drift was then run into the volcanic cement, and a winze sunk 90 feet down to bed rock, disclosing what is known as the blue channel. This channel was worked up and down stream for 1,400 feet of its length, establishing its approximate course as southwesterly, or nearly at right angles to the white channel. It had not only cut away a large section of the older channel, but had worn down its bed to 90 feet greater depth. Soon after this the extension of the white channel was discovered on the opposite hillside, several miles to the south, where the Hidden Treasure Mine was located. From this point of discovery it was followed up stream into the hill to the north for a distance of 10,000 feet, here again it was cut off by the same lava flow covering the blue channel. It is this blue channel that the Red Point Mine is located upon.

The Gold River Mining Co., having secured the ground to the northeast, had careful surveys made of the Mountain Gate Mine, and also of the rim rock (contact between the volcanic cement and bed rock) exposed on the surface for a distance of 8 or 9 miles to the northeast along the Forest Hill Divide. These surveys, including levels, furnished an assurance of the confinement of the channel within the company's ground. There were no points of the rim rock low enough to permit of the escape of the channel, it was virtually hedged in. Upon the basis of these surveys a point was located and the Red Point Tunnel started to tap the blue channel.

The data here presented concern this tunnel and the developments made through it. It was driven through slate bed rock in a southerly direction, the blue channel being tapped by means of an upraise 22 feet high, started at a point 1,840 feet in the tunnel. The general features of the Forest Hill Divide are described in the State Mineralogist's Report of 1890, and the map accompanying that report is partly based on the surveys made for the purpose just described.

Appended to this paper is a reduced copy of a portion of the above map, which will show the location of the Mountain Gate and Hidden Treasure developments in the white and blue channels, and

the work of the Golden River Mining Co., from the Red Point tunnel.

THE TUNNEL.

The tunnel is 7×8 feet in the clear, has a grade of 3 inches in 100 feet, and when originally run had a double track for the first 100 feet, with a drain ditch in the center, and from that point on a single track with the drain ditch on one side, and switches every 500 feet. The switches and double track have since been removed as there was no further use for them.

The rails used are 16-pound steel rails, with a gauge of track of twenty inches. The air compressor is located 200 feet vertically above, and about 300 feet distant from the mouth of the tunnel, the air being conveyed through a 3-inch pipe, which, in the tunnel, has valves and blowouts every 500 feet for the purpose of ventilation. There were no other pipes in the tunnel, except a 1-inch water pipe for drilling use (at the time of running the tunnel).

After the location of the tunnel it was necessary to build a wagon-road 6,500 feet in length, leading from the summit to the compressor site, a difference in level of about 700 feet, also to bring water a distance of 2,800 feet in a 2-inch pipe to supply the works. The steepness of the cañon in which the tunnel is located made it necessary to do a great deal of grading, and to build crib work to make room for a framing yard, blacksmith's shop, etc., the cost of which is given further on under the heading of "Yards, Dumps and Trails."

Work on the tunnel proper commenced on the 2nd day of July, 1886, and 108 feet were run by hand with an average force of 6 men per day. The compressor was started on the 5th day of August, and on the 31st of January, 1887, the tunnel had reached a length of 1,552 feet. The last 1,444 feet were run with an average force of $20\frac{1}{2}$ men per day. During the seven months the compressor was idle for $15\frac{1}{2}$ days on account of an accident to the air valves and the cracking of a casting, making it therefore only $6\frac{1}{2}$ months' work on the 1,552 feet, or an average of 234.1 feet per month, including the hand work. The two largest runs made for two consecutive weeks were 71 feet for the week ending August 28th (six days' work), and 84 feet for the week ending September 4th, or respectively 11.82 and 12 feet per day. The tunnel runs diagonally across the strike of the rock, which consist of strata of metamorphic slate alternating with sheets of diabase, diorite and barren white quartz.

The regular force of men employed (when full) consisted of

15 miners.....	working	8 hours per day.
2 engineers.....	"	12 " " "
2 drivers	"	12 " " "
2 blacksmiths.....	"	10 " " "
1 timberman.....	"	10 " " "

divided into three shifts and working two air drills on columns. The blacksmiths and timbermen only worked in daytime, unless on account of hard rock, it was necessary for the blacksmiths to work extra time.

COST OF SURFACE IMPROVEMENTS, PLANT AND TUNNEL.

	Total Cost.
Road.—6,500 feet long; average grade 1 foot in 10 feet; commenced May 26th, 1886; completed July 1st, 1886. Average force of men per day, 9.2; cost, including surveys and powder.....	\$963.00
Yards, Dump and Trail.—Commenced June 21st, completed July 31st. Average force of men, 5.6; cost, including crib work, timber and powder.....	508.05
Boarding house, office, blacksmith shop, stable, powder house, wood shed, framing sheds, snow sheds, etc.	2,310.10
Water Works.—Log Dam, 2-inch pipe, line 2,800 feet long in ditch and covered; commenced May 30th, and completed July 30th. Average force of men per day, 2.74. Cost, including surveys, powder and pipe.....	604.94
Air Compressor. Erection commenced July 1st; completed with pipe line to tunnel July 30th. Average force of men per day, 5. Cost of labor.....	970.00
One No. 44 Ingersoll straight-line compressor, 16 × 16 × 24; one 54'' × 16' steel boiler, complete; air tank, pump, three 3½-inch Eclipse drills and extras, freight and building 30 × 40 feet.....	7,819.86
Eight iron cars.....	1,200.00
Two tunnel horses, two team horses and buckboard	705.00
Total cost of plant.....	\$15,080.95

ACTUAL COST

Of 1552 feet of tunnel, 7 × 8 feet, up to February 1, 1887, exclusive of management, including 43 timber sets.

	Total Cost.	Cost per Running Foot.
Total labor (pay roll).....	\$11,418.47	\$7.36
Powder.—10,567 pounds Giant No. 2, and 325 pounds No. 1, at 26½ c., 41½ c., 10 per cent. off.	2,641.64	1.70
Fuse.—39,650 feet at \$5.50 per m., and caps \$45..	263.07	0.17

Wood.—402 cords at \$2.75 delivered.....	\$1,105.50	\$0.71
Charcoal.—1,604 bushels at 20 cents, delivered.....	320.80	0.21
Candles.—1,760 pounds at 16½ cents, delivered ...	290.40	0.19
Foot plank and ties.—7,355 feet of lumber at \$20 per mill., delivered.....	147.10	0.09
Timbers.—43 sets at 6 cents per running foot, delivered	46.76	0.03
Steel Rails.—16,640 pounds at \$60 per ton.....	510.00	0.33
Air and Water Pipes.—3 and 1 inch at 18 cents and 5½ cents per foot.....	521.86	0.35
Horse feed.....	281.25	0.18
Material.—Steel, oil, tools, etc.,.....	693.00	0.45
Freights, at \$1.25 per 100 hundred pounds.....	1,000.00	0.64
	<u>\$19,239.85</u>	<u>\$12.40</u>

With present reduced prices of powder, candles, etc., such a tunnel could now be run for \$11.25 or less per running foot.

From the upraise, 1840 feet in the tunnel, the channel was worked for a distance of 500 feet down stream to the west, and for a much greater distance up stream to the east. A branch tunnel was run at the same time under the easterly extension for a distance of 1,300 feet, and two upraises made into the channel to be used as gravel chutes. The second of these is 3,040 feet from the mouth of the tunnel.

This point reached, it was apparent that the gravel was not rich enough to warrant the extra expense of a bedrock tunnel and upraises. A slope was therefore raised from the end of the branch tunnel into the channel with a grade of 1 foot in 2½ to serve as a footway for horses. The upstream work in the channel was then continued as before, but without a tunnel underneath.

THE CHANNEL.

The gravel occupies a typical river bed with all its windings, bars, islands, pot holes, branches, etc., which only differs from the present rivers in its volcanic cement capping and somewhat greater grade. Its general course is southwesterly. It has a uniform grade of about 70 feet to the mile. Its bottom width is from 75 to 650 feet, average 200 feet. There have been encountered several islands; reaching heights of 12 or 14 feet above the average bed, and three large pot holes 80 to 120 feet long and 50 feet wide, and 9 to 14 feet deep. As a rule such holes are filled with large boulders and sand, and contain no gold, but in this case two of them contained rich

gravel; one in its southerly half, the other in its northerly quarter, the third was entirely barren. These holes were all found in hard bedrock. The soft rock is generally more uniformly graded, and has a level surface. Large trees, pines and cedars, almost unaltered, are of common occurrence in the volcanic cement immediately overlying the gravel, and this fact proves that this material was delivered in the form of a mud, and not as molten lava. Pine cones (apparently *Pinus Contorta*) and small branches have been found in the gravel. No fossil bones of any kind have so far been discovered.

THE BED ROCK.

The bed rock is principally metamorphic slate, often carrying large crystals of iron pyrites, and interstratified with calcareous schists, sheets of diabase and diorite, and quartz veins. The general strike of the strata varies from N. 25° to 32° W., and the dip from 45° to 80° to the northeast.

THE GRAVEL.

The gravel consists of boulders, principally of metamorphic schists and porphyrites with a very small percentage of quartz, intermixed with small pebbles and sand, and occasionally fine particles of iron pyrites. In some places the gravel of the old water courses is loose, with very little fine material between the boulders, and the latter are often covered with iron pyrites. As a rule the gravel in the mine has a bluish color, which gave rise to the name of "blue channel," but there are places where it is nearly black or red, and evidently discolored by percolating waters. When delivered to the surface and dried it has more of a grayish color. The gravel is "free," that is, it is soft enough to be washed without crushing, although blasting is resorted to as a means of facilitating extraction. The depth of the gravel is from a few inches to 16 feet, generally 7 or 8 feet in the center of the channel, thinning out to a mere seam on the rims. It is immediately capped with the volcanic cement, which forms a fine roof to work to. The overlying cement has a depth of 500 to 1,000 feet, and is in the form of beds with intervening layers of gravel. The latter sometimes are also gold bearing. The washed and rounded boulders are often 2 or 3 feet, and occasionally 6 or 8 feet in diameter. A very characteristic boulder of this channel is striped with white, greenish and dark colored streaks. The gravel often has a glistening appearance, and is found to be coated with minute quartz crystals. Wherever this has been observed the gravel is barren.

THE GOLD.

The gold is mostly in the form of what is known as "scale gold," consisting of flakes resembling fish scales, or the scaly particles in bran. In places, however, there are streaks of coarser gold and occasional nuggets of one or two ounces weight.

Size.—A number of "cleanups" were passed through a series of sieves of different meshes to determine the percentage of coarse, medium and fine gold. They were included under the heading :

Coarse Gold.—All that will not pass a sieve of 10 meshes to the inch. There are required from 600 to 700 of the finer colors of this class to weigh one ounce, and in these are included all colors, from the weight indicated up to the largest nugget.

Medium.—The remaining part that will not pass a 20-mesh sieve. This is more scaly and uniform in size, average 2,200 colors to the ounce.

Fine.—The remaining part that will not pass a 40-mesh sieve, average 12,000 colors to the ounce.

Powder.—The remaining part having passed the 40-mesh sieve, colors too fine to count, average 40,000 or more to the ounce.

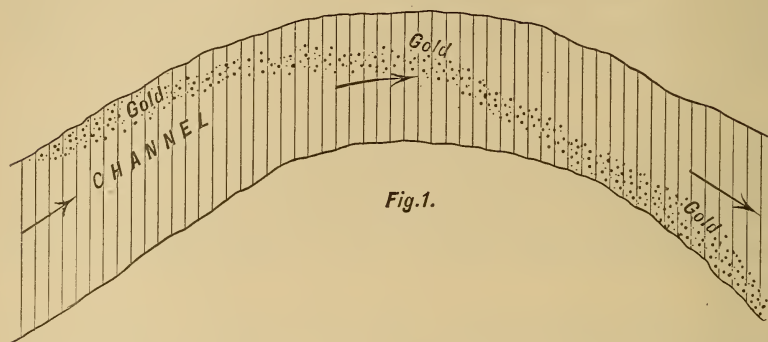
The following are the percentages by weight : *Coarse* 15.78 per cent. ; *Medium*, 48 per cent. ; *Fine*, 36 per cent. ; *Powder*, 0.32 per cent.

Value.—The gold varies in fineness (purity) from .928 to .937, and the ounce is valued at \$18.90 net. The purest gold has been found where the largest streams of percolating water were encountered in the gravel breasts.

Distribution.—The distribution of the gold in the channel is very irregular. Most of the gold is found on the bed rock. In some sections, however, it is mainly in the gravel above. The richest spot in this mine was found in a layer of gravel from 6 to 12 inches above the bed rock. At this point the bed rock was hard and smooth, and the channel straight. Some of the gravel was scraped up by hand, and contained as much as 33 ounces to the pan. For two months the average yield was \$7.50 per car load of 22 cubic feet. It appeared as if the gold had been carried by a freshet which spent its force at this particular place.

Again, the gold is found in paying quantities in an upper layer, from 40 to 10 feet above pay streak on the bed rock. There is one rule which applies to this channel, and perhaps to others with beds of stratified rocks. The consecutive strata having different degrees

of hardness will form riffles, so to speak, along or across the channel according to its course. Now when the gold dust strikes these riffles it is washed along them in the direction deflecting least from the course of the stream and concentrates toward the rim. If it strikes at right angles it lodges in the center, or scatters to the right and left. (See sketch, Fig. 1.)



This rule holds good for the main bodies of pay gravel. Of course if the bed rock is once covered it no longer governs the travel of the gold in this way, and this rule applies only to the pay streaks on the bed rock. In these main bodies the quantity of the gold again varies very much locally. It is generally found more abundant in cracks formed by the cleavage of the rock, at right angles with the strike, also around quartz veins, which are rough on the surface and hold the gold more readily, or where the slate is soft and thinly foliated. The gold dust will lodge in small pockets or pot holes and in cracks to the depth of a foot or more. The lowest rut in the channel contains very little gold, sometimes a little coarse gold, but the bulk of it is thrown on the sides or higher rock. It is also found more plentifully on the down stream side of islands and very large rocks.

SYSTEM OF WORKING.

A map of the working is herewith presented. A main gangway is run as near as possible in the lowest part of the channel, avoiding turns as much as possible. Cross cuts are run from this gangway every hundred feet, if practicable, toward each rim. They are not driven at right angles to the channel course, but diagonally across it, so as to avoid cutting too much bed rock to keep the grade down. Arriving near the rim, where the bed raises rapidly, the grade is abandoned, and the rock followed up high enough to make sure

that the true rim is reached. Generally the rim is indicated by sand and fragments of loose bed rock (float). The bed rock is so uneven and steep in places that car tracks on a higher level become necessary to facilitate the delivery of the gravel from the breasts to the cross cuts or gangway. These are about 4 feet above the normal grade, high enough to dump from one car into another. The cars running on these higher levels are of smaller size. In some places wheelbarrows are resorted to, and this makes the extraction expensive. The main gangway is kept ahead of the breasts as far as possible, and most of the breasting is done from the cross cuts and small car tracks. Blasting occurs only twice a day, at noon and 11 P. M., just before meal times. The roof being firm cement, no lagging is needed in timbering, only posts and caps are required. The posts, measuring not less than 10 inches in diameter, are placed from 6 to 8 feet apart, and sills are put under them where the bed rock is soft. Natural pillars of gravel are occasionally left along the sides of the main gangway and cross cuts, and at other points when the channel is wide. About one third of the gravel consists of boulders exceeding 5 inches in diameter, and these are not removed from the mine, but are used in building walls between the timbers along the sides of the gangway and cross cuts to give further security against flaking and caving of the roof.

VENTILATION.

Heretofore the ventilation of the mine has been accomplished by a No. 4 Baker blower run by steam power, and requiring 7.5 indicated horse power. However, quite recently a second blower (No. 4½ Baker) has been introduced. This is attached to a Pelton wheel, and will be run by water power for at least 6 months of the year. The air pipe used is 11 inches in diameter, and only one such pipe is required for ventilation, excepting where the channel is very wide. In such places a 7-inch distributing pipe is carried into the breasts, but usually the cross cuts and connections cause a sufficient circulation without such aid. The monthly cost of ventilation by steam power is as follows: (Average of six months.)

Two engineers at \$3.50.....	\$193.00
Thirty-three cords of wood at \$2.87.....	94.71
Oil, 6½ gallons.....	4.60
Eighty feet of new 11-inch pipe at 46 cents.....	36.80
Total.....	\$329.11

This shows for 3,064 car loads, 17 cents per car load.

TRANSPORTATION.

Four horses are needed for the transportation of the gravel, two on the day shift and two on the night shift. One extra horse is kept for reserve. One horse takes a train of 6 cars through the gangway to the chute, where the gravel is dumped. From the bottom of the chute, in the bed rock tunnel 44 feet below, the gravel is drawn in a train of ten cars, and the second horse takes it out to the dump house. The channel cars are iron dumpers of 22 cubic feet capacity. The tunnel cars have the same capacity, are also of iron, but the front ends are inclined and they are not dumpers. The latter are run out to the surface on to a self-dumping chair designed by Mr. H. C. Behr. This chair turns upon an eccentric axis, and the gravel is dumped to the washing floor 30 feet below. The driver does the dumping. Each train has a break car attached to it. The total distance from the breasts to the dump house is 6,514 feet, or nearly 1.25 miles, 3,273 feet being in the channel gangway, and 3,241 feet along the tunnel to the surface. The number of cars used in the mine at present is 30. The monthly cost is as follows: (Average of six months.)

Feed for horses.....	\$62.50
Wages of 4 drivers, at \$3.00.....	324.00
Wages of 2 Chinamen, at \$1.75.....	98.00
Car wheels, oil, etc.....	20.00
Total	<u>\$504.50</u>

This gives for 3,064 car loads 16 cents per car load.

COST OF LABOR.

The average cost of materials, transportation, ventilation, and management is easily calculated, but the item of labor is more difficult to determine. It varies with the width and depth of the pay gravel, with the number of Chinese employed, with the unevenness of the bed rock, with amount of work in erecting new buildings and making other improvements, and with the labor required to protect the company's property in times of heavy snows and freshets.

The results of a number of figures give the following averages: Average number of men employed daily, 58.5, (22 whites and 38.5 Chinese). Average cost of labor per man, \$2.23. Average number of carloads extracted, per day's labor, \$1.87.

This estimate includes all hands employed on the works, underground and on the surface.

A man breasting gravel will take out from 2.80 to 3 carloads a day, and sometimes a little more. This also depends on the depth and compactness of the gravel. As many as 220 car loads have been taken out in one day by the above-cited force.

The pay roll for six months, omitting labor already cited under headings "Ventilation" and "Transportation," shows an average of \$3,169.75 per month. This gives for 3,064 car loads extracted a labor expense of \$1.03 per car load.

COST OF MATERIALS

of which only yearly inventories are taken (for the year 1892):

Timbers	\$931.87
Lumber	300.00
Hardware	585.18
Rails	391.90
Air pipe	342.00
Car wheels, etc.	241.00
Sundries	120.93
Freight ..	575.47
Total	\$3,488.35
On hand (estimate)	656.28
	\$2,832.07
For one month	\$236.00

MATERIALS USED IN ONE MONTH.

With an average extraction of 3,064 car loads.

1,191 pounds powder, No. 2, at 10 cents, (average of 6 months)	\$119.10
4,800 feet fuse at \$6.00 per m.	28.80
1,766 caps at \$5.00 per m.	8.83
615 pounds candles at 10½ cents.	64.57
11 gallons coal oil at 26 cents.	2.86
5 " engine oil at 65 cents.	3.25
1½ " cylinder oil at 90 cents.	1.35
6 " lard oil at 90 cents.	5.40
11 " car oil at 35 cents.	3.85
181 bushels charcoal at 20 cents.	26.20
3,662 pounds hay at \$25.00 per ton.	45.77
1,669 pounds barley at \$1.80 per hundred.	30.04
33 cords of wood at \$2.87.	94.71
Timbers, lumber, hardware, air pipe, rails, car wheels, sundries, freight, cited in the above yearly inventory.	236.00
Total	\$670.73

This gives, after deducting materials already entered in estimates of "Transportation" and "Ventilation," \$443.41, or 14½ cents per car load.

COST OF MANAGEMENT.

The monthly cost of management, including superintendent's salary, office expenses, travelling expenses, cablegrams, expressage on gold, taxes, etc., average of six months, \$649.00 or 19½ cents per car load. Total expense per car load is therefore :

Ventilation.....	\$0.11
Transportation.....	0.16
Labor.....	1.03
Materials, etc.....	0.14½
Management.....	0.19½
Total	<u>\$1.64</u>

PRODUCTION.

The total production during five years, from January 1st, 1888, to December 31, 1892, was 140,345 car loads, yielding \$308,245.40, or \$2.20 per car load. The total production of the mine has been \$363,473.60 from 5,073 running feet of channel, or \$71.65 per running foot.

WASHING THE GRAVEL.

The dump house, in which the gravel is washed, has a floor 31 feet below the car track. This floor slopes from the two sides toward the center, which is provided with a sluice box 16 inches wide in the bottom, and having a grade of 15 inches in 12 feet. The gravel is dumped on to this floor and washed with the stream from a three-inch nozzle under 25 feet pressure.

The line of sluices, drops, etc., is as follows (beginning at the washing floor): 157 feet sluice boxes, vertical fall or drop, 30 feet; 11 feet ground sluice, 36 feet sluice boxes, 10 feet drop; 24 feet ground sluice, 182 feet sluice boxes. After this the gravel washes down a steep cañon with several falls and short sluices for a distance of 1,500 feet, then passes through a double flume and over an under current.

The upper sluice is nominally divided into sections, the upper 59 feet being called the "Upper Sluice," and the lower 98 feet the "Lower Sluice." The next two sluices of 36 and 182 feet are called the "Cañon Sluices," and everything below them is credited to the "Tailings."

In the "Upper Sluice" no quicksilver is used, and it is cleaned up every three days, or oftener if the gravel is very rich. All the other sluices are supplied with quicksilver. The "Lower Sluice" and

"Cañon Sluices" are cleaned up at the end of each month, and the "Tailings" once a year.

The riffles used in the sluices are made of wooden strips 3 inches high by $1\frac{1}{2}$ inches thick, topped with strap iron half an inch thick. In the "Upper Sluices" they are 6 feet long, which is a convenient length for frequent handling. In the "Lower Sluices" they are 12 feet long. Six of these riffles fit into one sluice box, and leave an inch space between each. Every 12 feet a Hungarian riffle (an iron grating) is introduced to disturb the current of the water. In the "Cañon Sluices" ordinary riffles, wooden blocks, old car wheels, and cobble stones are used, all forming good gold catchers.

The following percentages of the total yield are obtained from the different sluices, etc. (Taken from an average of 12 months) :

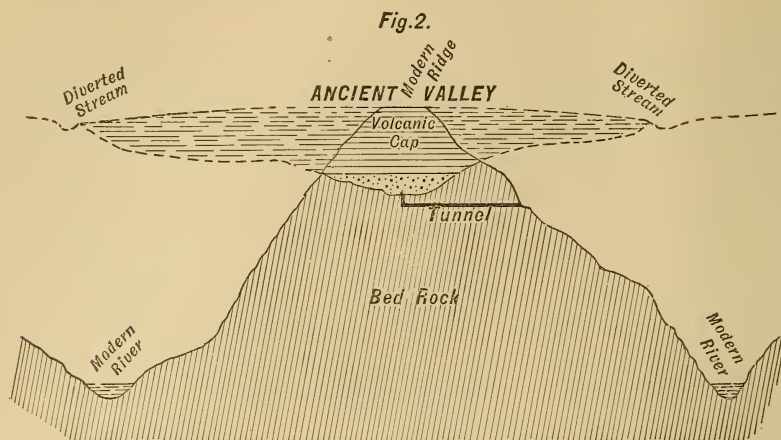
Upper Sluice (without quicksilver).....	82.48	per cent.
Lower Sluice(with quicksilver).....	3.89	" "
Cañon Sluice, 36 feet " "	2.86	" "
" " 182 feet " "	3.24	" "
Tailings.....	5.72	" "
Panning Tub.....	1.63	" "
Blowings (black sand) " "	0.18	" "
		<hr/>
		100.00 per cent.

DISCUSSION.

Before reading the paper Mr. Browne said :

"The drift mine, of which Mr. Hoffmann's paper treats, is in one of the ancient river beds of the westerly flank of the Sierra Nevada. These are found in a striking topographical position, occupying the summits of the modern ridges, high above the present streams. This apparently anomalous position is due to the displacement of the ancient streams by lava and mud flows from volcanic eruptions in the high Sierra. These flows filled the old river beds and diverted the streams, which cut new beds to gradually greater and greater depths, leaving eventually portions of the gravels of the ancient rivers, with their volcanic caps to form the modern ridges, as shown in the following cross section. (Fig. 2).

The gold is contained mostly in the bottom layer of gravel under the volcanic cap. The method of mining is by driving a tunnel in from the hillside to tap the bed and drain off the water, and to serve as a tramway for delivery to the surface. The auriferous gravel is



excavated, carried to the surface, and dumped on to a sloping floor at the mouth of the tunnel, and washed thence through a line of sluices, provided with riffles to catch the loose particles of gold—the gold dust.

Much of the data furnished by Mr. Hoffmann cannot be found in a published form, and is of special value to engineers in making estimates for similar enterprises.”

After reading the paper Mr. Browne added :

“Aside from the figures giving working results, Mr. Hoffmann has observed several occurrences which I have not heretofore heard described, and which appear to me as having special interest. These are particularly: the poverty of the gravel where the boulders are coated with microscopic crystals of quartz ; the effect of the strike of the natural riffles relatively to the course of the river in determining the position of the pay streak ; and the greater the purity of the gold, where large quantities of percolating water were encountered in the gravel breast.

This latter observation indicates that the gold particles have undergone a slow process of purification by prolonged washing.

There is no doubt in the minds of those most familiar with the occurrence of auriferous gravels that the gold dust was derived from the degradation of the gold bearing quartz veins. But it is a matter of common information that the placer gold is purer than the gold in the quartz veins, and this fact gave rise to disputes concerning its origin. It was asserted by some theorists that the greater purity showed a difference in origin. However, the evidences of the deriva-

tion of the placer gold from the quartz veins are conclusive, and it remains only to explain the greater purity. I have for some time past been collecting information on this subject, and find the following averages from a large number of our California mines: Gold taken from placers, .890 fine; from quartz veins, .820 fine. The other constituents are mainly silver, partly baser metals.

The theory has been advanced, that the silver and baser constituents when exposed to the action of air and water are partially oxidized and dissolved, while the gold remains unaltered. In this way there results a purification of the outer film. The aggregate effect on the fine particles would be greater than on the large nuggets and in fact the greater purity of the fine dust, and of the outer films of nuggets, is well known to dealers in placer gold.

Mr. Hoffmann tells me that, in the Red Point mine, in passing from a comparatively dry into a very wet section the purity of the gold dust always increases, generally from .003 to .005, or say one half per cent. Though something of the sort might have been anticipated, it is the first time I have heard of its being actually observed."

MR. MANSON.—"Aside from the technical interest that the mining engineer would take in this paper, there is a great deal in it and in Mr. Browne's explanation of the occurrence of these two sets of river channels and the obliteration of one set with the lava overflow, that interests the geologists.

I have had occasion to examine the western slope of the Sierras from a few dozen miles south of the point so interestingly described in this paper, to Mt. Shasta, and the western slope of the Rocky Mountains in Eastern Washington, Idaho and Montana. In that area, embracing parts of California, Washington, Oregon, Idaho and Montana, there are about 150,000 square miles, which are or have been covered with lava. Towards the northern edge, up in Montana, Idaho and Washington, the lava is from half a mile to a mile and a half thick, and is of dense basalt. Towards the southern edge or limit it appears to have degenerated, or certainly decreased in hardness as well as in thickness, and in some instances it is a mud lava that can be picked and handled without any very great trouble. In the Sierras the first set of river channels appears to have been formed during the period of denudation that followed that upheaval.

This denudation of portions of the Sierras amounts to about two miles in thickness, and in some instances to more. As that two miles was denuded from the western slopes of the Sierras, which was a line of lighter crust in process of upheaval, the amount of denuda-

tion lightened the load upon the crust and destroyed the state of isostatic equilibrium that the crust is always in. This caused the crust to upheave more. The denuded materials transported down the sides of the Sierras by water and gravity, were deposited in the great valley of California, and this already in process of sinking was more heavily loaded. The additional load on the sinking area caused it to settle still further. So that denudation acted in a double way to accentuate the difference of elevation between the valley and the mountains; that is, the continuous denuding of the one caused the building up of the other. At the same time the process caused the valley to settle more, and the mountains to upheave to a greater extent. Towards the latter part of the Tertiary, and probably running well into the Quaternary Period, the process of denudation seems to have been interrupted by this lava flow, as Mr. Browne described, and a new set of river channels started in. In most instances these ran across the others, and in the modern rivers the richest deposits have been found just below where they had cut through the ancient river channels. The gold in the modern channels being the result of a double set of concentrations, first in the denudation and the filling up of the ancient river channels, and finally in being re-concentrated in the modern rivers, leaving the enormously rich deposits that the forty-niners worked with such good results.

I regard this paper as an exceedingly valuable one, because it describes mining as a business enterprise. Mining in the early days, and even up to 1877, was largely a gambling operation; after the mine was located the stock was put on the market, and it made but little difference whether the mine was valuable or not. So the mines were not systematically worked, and in many of the old river channels there are wonderful deposits yet, and, I believe, that the mining engineer and the geologist have before them a field of wonderful fertility in following up these river channels, not only in the high Sierras, where they are covered by the lava caps, but by following them down into the plains below the level of the present alluvial surface of the valleys, and also in the drift mines well under the surface of the present rivers. And I believe that this is going to be a line of mining which will be followed very largely in this country, and that projects of this nature will ultimately prove very attractive to capitalists."

MR. STRIEDINGER.—"Mr. Hoffmann's paper fills, in a masterly manner, a long-felt gap in the literature on gravel mining. How

thoroughly and economically the exploitation of the Red Point Drift Mine, as carried on under his superintendence, is shown by this abstract from his reports.

Mr. Browne has not mentioned the fact that he and Mr. Hoffmann executed the original survey of this mine, and subsequently located the tunnel, which, by crossing the ancient river channel about 20 feet below its deepest point, causes a perfect drainage of the underground workings. There are very few drift mines which are so well laid out.

Drift mines are not confined to the Pacific Slope of our Sierra. Not quite a year ago I discovered some drift mines on the westerly foot hills of the Andes, near Barbacoas, Republic of Colombia, S. A. Drier drift mines than the "Red Point" are usually opened by means of inclined shafts with drifts extending from their bottoms.

MR. BROWNE.—"The deep drain tunnel is necessitated by the amount of water contained in the channel. In the Red Point this amounts to 35 or 40 miner's inches, in the Mountain Gate and Hidden Treasure to 40 inches each, in the Mayflower, further down the ridge, to 75 inches. If mined through deep shafts the handling of such quantities of water would eat up the profits.

There are a series of drift mines in the Harmony Ridge, near Nevada City, however, where the gravel is almost dry, and the work there is most profitably carried on, as stated by Mr. Striedinger, through inclined shafts. The advantage of the inclined shaft is that it is shorter, and it may be run down on the rim rock until the bottom is reached, and it is not necessary to rely upon a vague estimate of the depth or position of the channel bed, as might be the case in driving a tunnel. But it should be borne in mind that every miner's inch means about 70 tons of water per 24 hours, and that the expense of lifting a very few inches will often amount to more than the expense of hoisting the total amount of gravel extracted. For example, the Mayflower mine delivers about 140 tons of gravel per day, and there runs through its drain tunnel nearly forty times this weight of water.

THE BERRY TANGENTIAL WATER-WHEEL BUCKETS.

BY A. E. CHODZKO, C. E., M. E.

Having investigated the conditions of operation in the S. L. Berry tangential wheel, the writer submits the following remarks:

Briefly recalling the three main requirements for efficiency in this class of wheels, to ascertain to what extent they are fulfilled by the Berry wheel, there is:

1st.—The loss of efficiency, due to the carrying by the wheel of a wedge of dead water, created by the diversion of an impinging jet on the face of a bucket, should be avoided by making the wedge part of the bucket itself, so the pressure of the jet, regardless of impact, is thereby only to be considered.

2nd.—The direction of the jet should meet the wheel tangentially to the circumference of the point where the jet strikes the bucket, and normally to the face of this latter.

3rd.—The water should leave the wheel with no absolute velocity.

The first condition is complied with in the Berry wheel, as it is in the Pelton, Dodd and others, *i. e.*, by casting the bucket with a sharp-edged partition in the plane of rotation of the wheel, its cross section in a perpendicular plane approximating the conoidal shape of the eddy above referred to, and its effect being to split the jet on both sides of the plane of rotation.

As Mr. Berry remarks, the first part of the second condition is strictly satisfied, with each jet, for one particular bucket only, whatever be the shape of this bucket; the rectilinear motion of the water makes this an imperative fact.

Such is also the case with the second part of this condition, namely: that the jet must strike the bucket normally to its face, whenever this face is either flat, or concave towards the jets.

Mr. Berry, in adopting a convex surface for his bucket, claims to comply with this requirement practically in all the relative positions of the jet and of the bucket.

Fig. 1 shows the pitch and size of the buckets as represented on the drawing annexed to Mr. Berry's application for a patent.

Let us represent the size of the jet, and assume, first that the velocity of the water is constant in all the portions of a section of this jet, and, second, that another claim of Mr. Berry's is strictly

justified, namely, that the sharp lower edge of the bucket, as it penetrates the jet, merely severs a portion of it without deflecting the remainder.

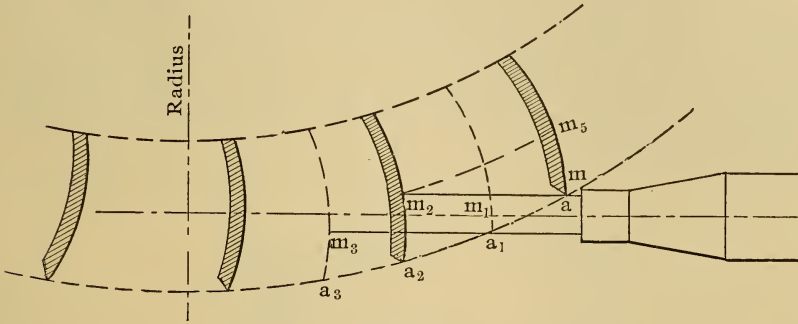


FIG. 1.

The first contact between the jet and the bucket occurs at m , when the sharp edge of the bucket a is grazing the top of the jet, and the last contact is at m_3 , in the position a_3 of the bucket, when the following one has come in a_1 and shuts off the jet of water. The action of this latter is partial from m to m_1 , as also from m_2 to m_3 , when two buckets are affected; it is complete from m_1 to m_2 , when one bucket only is engaged.

The wetted part of the bucket, *i. e.*, the portion of it reached by the jet, will be $m m_3$; beyond the point m_3 , and towards the center of the wheel, it does not matter whether the bucket's face be flat or curved.

Since assuming a constant velocity in all parts of the jet's motion, we may consider that in every position its action on the bucket is concentrated at the center of the impinging section of the jet. If this latter is normal to the bucket's face, the center of curvature of this face should, in all positions, be on a parallel to the direction of the jet, drawn through the center of the figure of the impinging section. The path of these centers of curvature will be above the center line of the jet, between the position a and a_1 of the bucket; it will coincide with the line $m_1 m_2$ from the position a_1 to the position a_2 , and then pass below the center line of the jet.

But owing to the small range of variation $m m_3$ of the points of impact of the jet, a properly selected arc of circle would vary but slightly from the true curvature of the bucket's face. This statement would, of course, become erroneous should any deflection of the jet take place when entered by the cutting edge of the bucket.

But if this does not happen, the Berry bucket ought to answer satisfactorily the last part of the second condition.

As to the discharge of water in the Berry wheel, after the jet has been split by the sharp apex of the buckets, the water is projected in two principal planes, *i. e.*, the plane of rotation of the wheel, and a plane perpendicular to it. What is to be said about this latter applies to the Berry and other similar buckets, and shall first be dealt with.

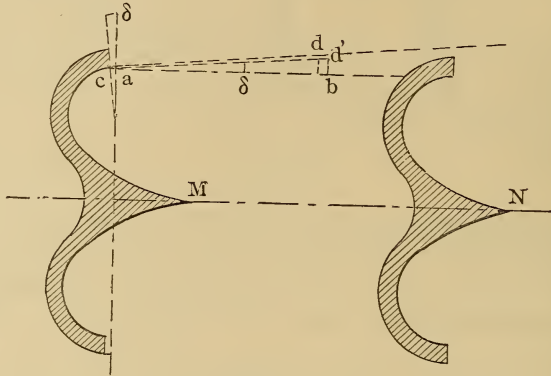


FIG. 2.

In his analysis of the water's action in his wheel, Mr. Berry appropriately remarks that whilst the true form of the bucket, in a plane perpendicular to the plane of rotation of the wheel, should be such that water would follow the direction ab , parallel to the plane of rotation MN , this would cause this water, whose relative velocity is always considerable at a , to splash against the next incoming bucket, thus impeding its free discharge; to avoid this the releasing edge is kept a little within the point a , with respect to the entrance of water in the bucket, so that the line of discharge cd being tangent to the inner curvature of the bucket, will clear the next one; in this manner:

$$cd \text{ or } ad' = \frac{ab}{\cos. \delta}, \text{ } ad' \text{ being parallel to } cd.$$

As long as δ is small, *i. e.*, as long as the pitch of the buckets is sufficiently large, $\cos. \delta$ will differ but little from 1, and the absolute velocity of discharge ($ad' - ab$) remains small.

If we next consider the discharge in the plane of rotation of the wheel, it seems, at a first glance, that a section of the bucket semi-circular, or about so, would give the escaping water a relative veloc-

ity equal to the tangential velocity of the wheel, *i. e.*, an absolute velocity equal to o .

But aside from the fact that a concave section does not agree with the requirement of a normal impact of the jet, another circumstance occurs which condemns a circular form of buckets as far as the discharge of water is concerned, for as soon as the water has entered the bucket, it becomes, so to say, a portion of the wheel, and partakes of the effect of its rotation upon all its parts. Centrifugal force will therefore increase the friction of water upon the outer half $m n$ of the bucket, and retard its relative velocity.

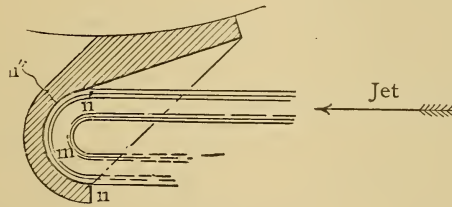


FIG. 3.

It might, indeed, be argued that this same force will, to a less extent, however, decrease the friction on the portion $m n'$ of the bucket, and partly balance thereby the increase of resistance on $m n$, but the formation of an inert eddy, or body of dead water n'' , might also occur, and a loss of efficiency would result. This defect of concave buckets is considerably reduced, and may even be avoided in the Berry system.

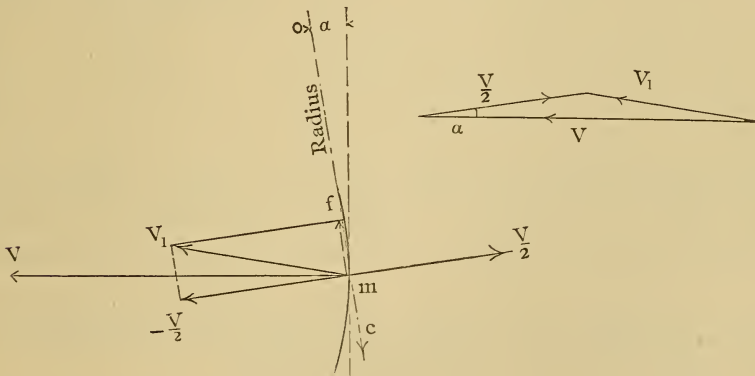


FIG. 4.

A simple diagram shows that here, instead of impeding the discharge of water, the centrifugal force acts in its favor.

Let m be the point where the jet meets the face of the bucket, and mo the direction of the radius. V being the absolute velocity of the jet, and $\frac{V}{2}$ the tangential velocity of the wheel, the triangle of forces constructed on V and $\frac{V}{2}$ gives a resultant V_1 , which, as rightly remarked by Mr. Berry, is the relative velocity of the jet on the wheel.

This same triangle, if a is the angle of radius, and mo normal to the direction V , gives :

$$V_1^2 = V^2 + \frac{V^2}{4} - V^2 \cos. a$$

which formula, for $a = 0$, becomes

$$V_1 = \frac{V}{2}$$

Now if we apply V_1 at the point m , it can be converted into two velocities, one equal and opposed to $\frac{V}{2}$ and the other along mf ; but the centrifugal force acting along the radius om gives a component velocity mc opposed to mf . It can readily be conceived that this component may balance exactly mf , against which, moreover, the weight of the water would act, independently of the centrifugal force.

Effectively, the preceding formula :

$$\begin{aligned} V_1^2 &= V^2 + \frac{V^2}{2} - V^2 \cos. a \\ &= V^2 \left(\frac{5}{4} - \cos. a \right) \end{aligned}$$

gives

$$V_1 = V \sqrt{\frac{5}{4} - \cos. a},$$

and we see, without any further computation, that V_1 varies as the first power of V , whilst the centrifugal force and its consequent velocity varies for a given mass of water, as $\frac{V^2}{R}$ i. e., as the square of V . In other words the action of the centrifugal force would vary with the velocity of the wheel more rapidly than the component mf , since V is always a quantity greater than 1.

In each particular case the velocity V of the jet being given, as also the radius of the wheel, calculated to suit its local duty, a mean value of a , applicable to the limited region of action of the jet on

the buckets, should be determined to balance the component *m f*. This all amounts to saying that the proper position of the nozzle should be figured up to suit each special case.

As a summary of these cursory remarks, I conclude that the Berry bucket is a very rational, and to all appearances, an important improvement in the construction of tangential wheels.

WORKSHOP LIGHTS.

In this day of lecturing about wastes of one kind or another it is to be noted that waste of light in workshops has been reached, and it is high time. In districts where anthracite coal or wood is burned, and the interior of a factory or workshop can be kept fairly clean, there is no doubt concerning the advantage of top reflectors, especially when electric lights are employed.

In machine shops, which are among the most difficult to light, there are two requirements, one of general light and another of local light, unless, as is hardly possible, a shop is illuminated to such degree that local lights are unnecessary.

To hang up electric lights beneath a dark ceiling and walls, is like firing with the furnace doors standing open. Half the current and the money it costs are wasted. Where this is written we have a room twenty feet square lighted by one sash about three by five feet in the center of the ceiling, which for comfort and use is better than four windows of twice the size, or eight times the area, around the sides of the room. The light is equal in all parts and sufficient, being deflected by inclined white surfaces below the glass.

Top lights have useful effect in a general way four times as great as side lights, and there is no doubt as to the advantage of arrangement in this respect, the best examples showing that with lamps the lights should be shaded below, and the reflected light alone depended upon.

The angle of reflectors must be arranged with respect to the size of rooms, and height of lamps above floors. This is a simple problem in a room that is square or nearly so, but more difficult in the case of a long narrow room. In that case the lights should be placed at intervals equal to twice the width of the room.

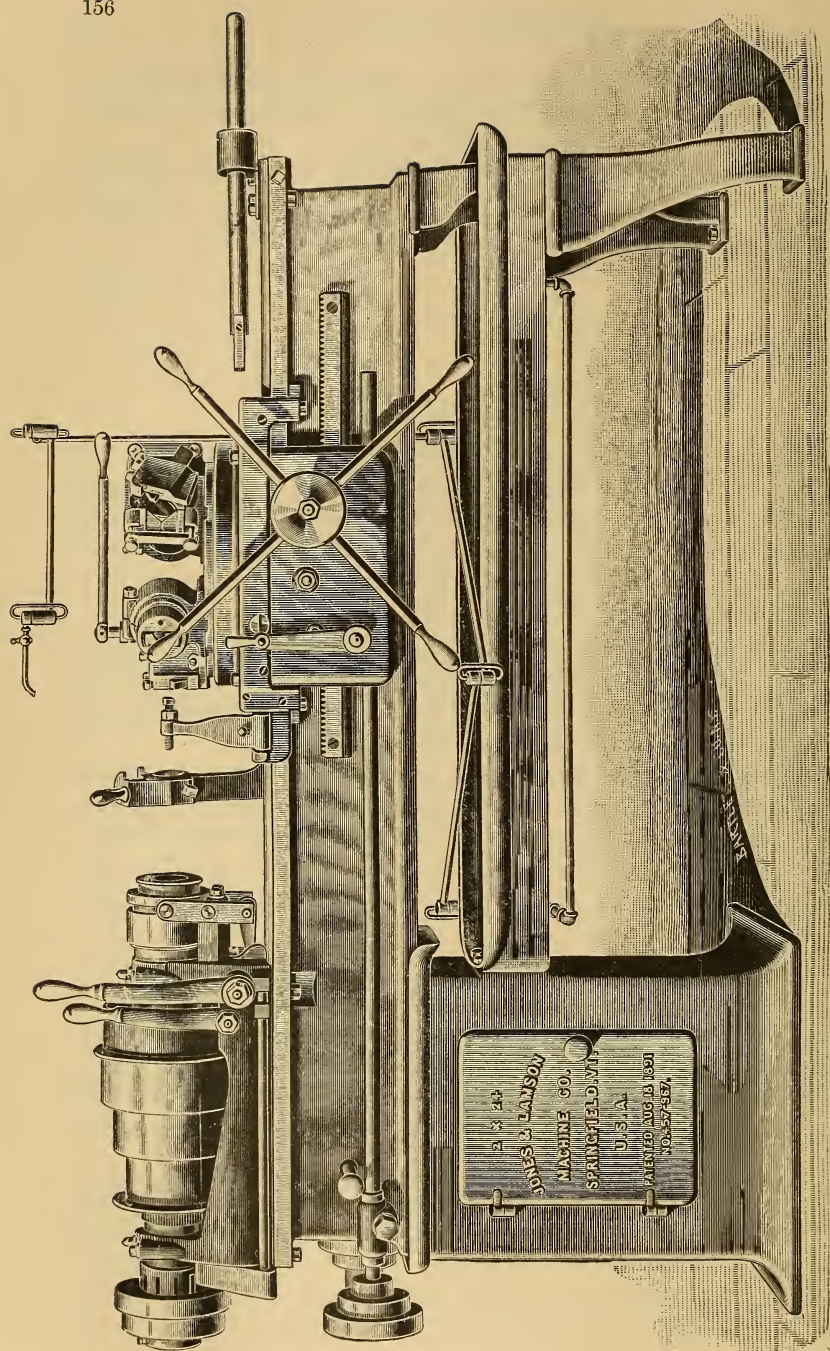


FIG. 1. IMPROVED TURRET LATHE.—JONES & LAMSON MACHINE CO., SPRINGFIELD, VERMONT.

AMERICAN TURRET LATHES.

To a person who has watched the development of what may be called "cold processes," in cutting and shaping metal during the last forty years, the change has been striking and phenomenal, especially in what may be called exact or finishing processes.

The cold processes are five in number, turning, planing, drilling, milling and punching. These, and their modifications or adaptations, cover nearly all the functions of what we call machine tools. A good deal has been added in each class of implements, but especially in milling there has been a change so great that the art, as it now stands, is almost a new one.

The improvements have not been general over the world, but have at first advanced in certain countries and localities, and then spread by a slow course of evolution to other countries and places, and in the slowness of such spread is a great commercial fact, not taken into account by industrial economists.

During the interim which improvements in shop processes require to spread over a country, the original inventors enjoy a monopoly long enough and strong enough to found successful manufactures, and thus, by the natural order of things, enjoy a kind of exclusive right, analogous to a patent. Such periods are not short, and may consume ten to twenty years, when one would suppose as many months would answer in this day of patents and printing.

American mechanics have a foremost place in the development of turret lathe and milling processes. The founding of the U. S. Armory, for small arms, at Springfield, Mass., about fifty years ago, in the midst of an ingenious and skilled population, and the early adoption there of the duplicating or interchangeable system, gave a start to these exact processes, which, as a single fact in machine-tool improvement is one of the most notable in the whole history of the art. All at once, or within a few years, milling advanced there far beyond any conception of it in other countries, although the system had been previously invented in France. A good deal of such machinery was made for foreign governments, including Great Britain, for applying the American system to the manufacture of small arms, but the processes did not at that time, and for long after, find their way beyond the armories.

Twenty-five years later the same processes were applied to the finer art of watch making, and for a second time American mechan-

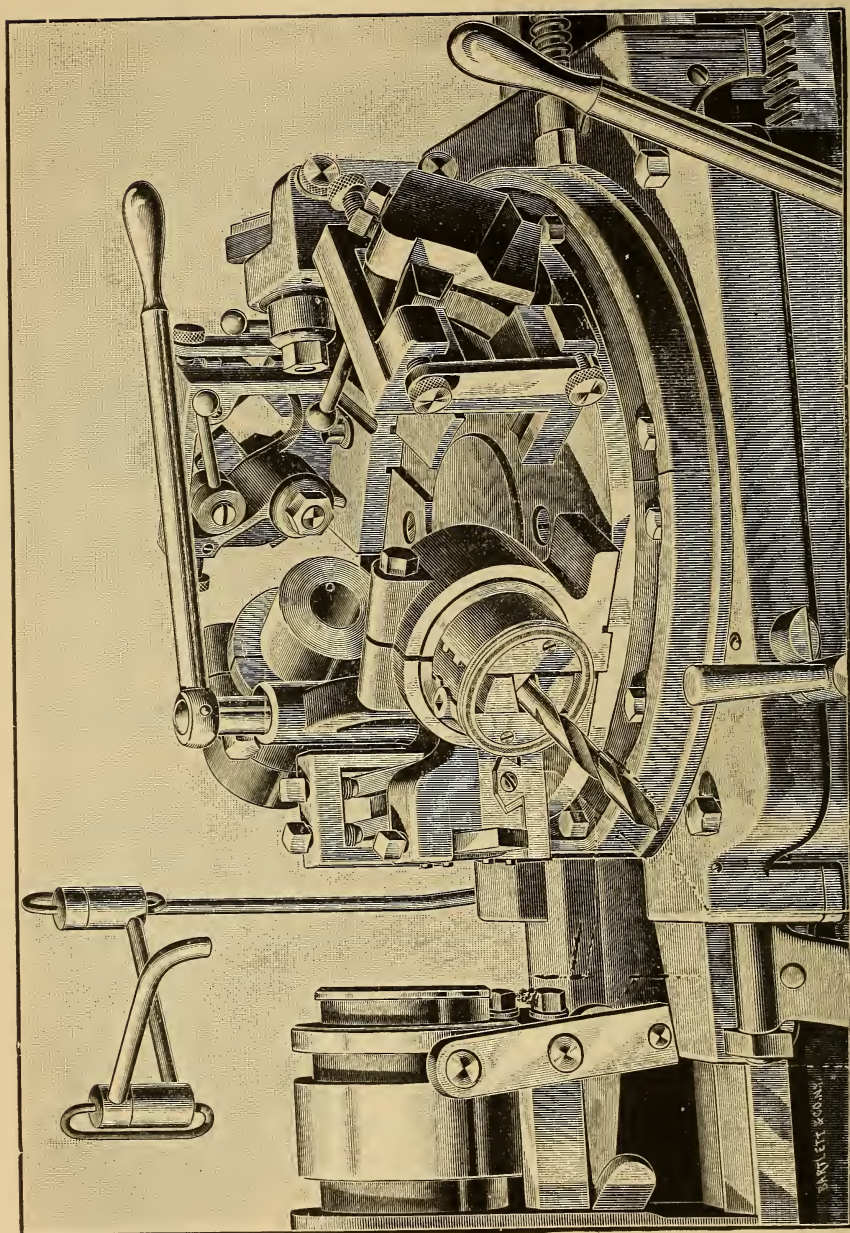


FIG. 2. FLAT LATHE TURRET & TOOLS.—JONES & LAMSON, SPRINGFIELD, VERMONT.

ics made a notable advance in milling, because watch making by machinery consists mainly in milling. The result, after some years of failure, was a great success, and American watches, produced by labor that costs five times as much as in Geneva, were sold in competition with the Swiss trade in London.

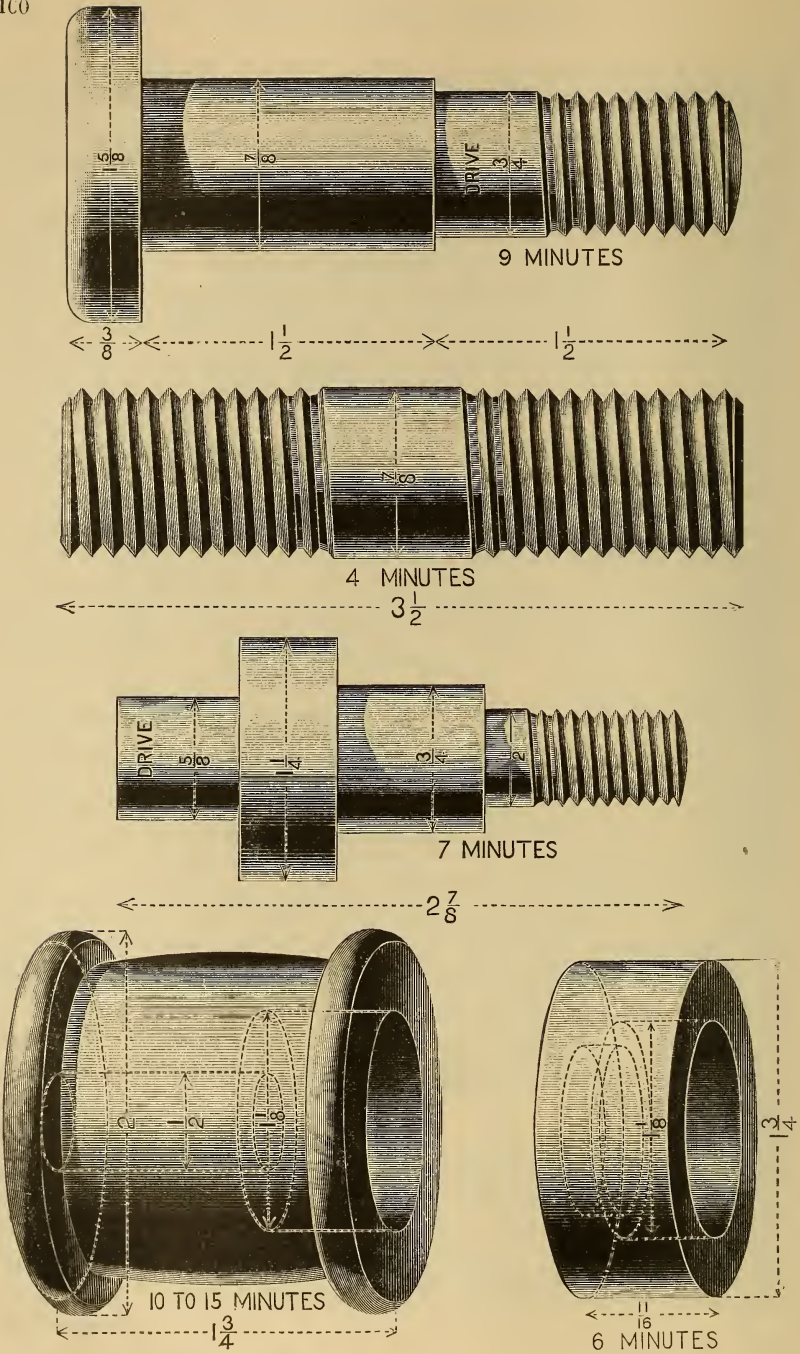
One innovation in what we have called gauge processes had its origin in England, not by milling, if the nature of the cutting implements are considered, but in other respects embodying all the essential features of the American gauge machines, such as the revolving turret, hollow spindle, and gauges for movement. These English machines, however, were fitted with turrets at the side of the work, and employed single tools instead of milling ones. The result was the attainment of very exact work at a cost so much less as to astonish even the makers of the machines.

A machine could be profitably set and adjusted to make but a few pieces, such as collar studs, and the work could be done by boys. This led to a division of the work into turret and slide-lathe work. Such pieces as were small enough, and when a number were required, were drawn on separate sheets that went to a special department.

American makers adhered to the milling or multiple cutters with the turrets in the line of the spindles until recently, but now, and for some time past, have taken up the single-tool method, and have thus widened the capacity of the milling-machine methods, and have added a number of improvements, among which are the flat turret plates illustrated in the drawings.

Among the firms early in the manufacture of milling machinery and turret lathes, were Jones & Lamson, of Springfield, Vermont, now the Jones & Lamson Machine Co. For sixty years or more this firm has made a speciality of machines for producing exact forms. Some examples of the latter machines made by this company are shown in the drawings accompanying this article, and now to be referred to.

Figure 1, on page 156, shows a complete turret lathe to produce a great variety of work, and is much heavier and stronger than such implements were formerly made. The main elements of the machine are familiar to most of our readers, and do not need description, but the turret or tool support vary greatly from the old method of supporting the tools in stems or "chucks" inserted in round holes bored radially into the sides of a revolving turret block, the tools overhanging, and without any lateral rigidity except such



EXAMPLES OF TURRET LATHE WORK.

as the stems of the chucks afford. This was done for milling when the strains were balanced across the center, and no lateral support required, but was wholly insufficient when single tools were used, the same as in a common lathe.

This led to what the makers call the flat turret, shown in the enlarged view Fig. 2. In this it will be seen that the tools of various kinds are mounted on a flat swivelling plate that extends under or near to the cutting point of the tools, and thus supports directly the thrust of cutting the same as in the case of a lathe cross slide. The movements and functions of the turret plate are the same as heretofore, with the addition of a power traversing feed imparted by the motion-rod seen in front at Fig. 1.

The English machines have in addition a cross-traversing movement of the turrets, so the tools pass to the side of the work, permitting the use of a sliding head or tail stock, and this, we imagine, can be used to advantage for some kinds of work, such as chasing long screws, or turning parallel pieces of some length.

In the present machines the end support is substituted by an ingenious system of back stays, or following-rest supports, that may be even more efficient than a tail center, unless in plain turning, and this can of course be done as well on a simple slide-lathe.

Some years ago we sent for some examples of work done on single-tool turret lathes, with the time and expense of producing the pieces. The work was shown to people here and caused a good deal of astonishment, but nothing more. Since then some of the milling class of turret machines have been introduced in the shops here, but so far as we know none of the single-tool kind, such as is here represented.

The Jones & Lamson Company have sent the examples shown opposite, the dimensions and time to produce them marked on each piece, and from these comparison can be made with the expense of the same work when made in the usual manner on slide-lathes.

The limitation of such processes is of course the extent to which duplication can be applied, or to the division of work in a machine shop. The gain is direct profit, unless the system is in general use, and estimates made accordingly, so that those who first adopt it are likely to find it very profitable, especially as there is at this time no rules or even knowledge of the cost of making standard work, such as must exist when implements of the present kind are in use.

ELECTRICAL STORAGE BATTERIES.

That electrical storage batteries are in a course of evolution is sufficiently proved by reading over what is perhaps the most comprehensive essay on the subject that has appeared, a paper by Mr. P. G. Salom, read before the Franklin Institute last year. The lecturer went over the usual history of storage batteries as follows :

"A storage battery is not a new thing. Away back in the early days of this century, a French chemist, named Gautherot, observed that the plates of a voltameter gave a reverse current. A voltameter is an instrument for measuring the galvanic current by means of the chemical action produced, and Gautherot observed that after a galvanic current had been passing through the plates of a voltameter for some time, and was then discontinued, and that if he connected the terminals of a voltameter a current was obtained in the reverse direction, and this is the germ of a secondary battery. If, for example, a current of electricity is passed between two lead plates, and indeed between any two plates, and then discontinued from the source of the current, and their terminals again connected through a voltameter, you will observe a deflection. It was first thought that this secondary current was due to electricity actually charged on the plates in a manner similar to the alleged charge on a condenser, but it was soon discovered that it was due to the substances, (gases or oxides as the case might be) derived from the original chemical decomposition.

From 1801 to 1859, the subject was studied by the most eminent chemists and physicists of their time, viz : Ritter, Grove, Oersted, Faraday, Becquerel, and many others.

In 1859, Gaston Planté, who made the most exhaustive researches in secondary batteries, constructed a secondary pile which is really the parent of all modern accumulators. A number of attempts have been made since that time to store the electrical energy of a dynamo, the most notable of which are those of Messrs. Thomson and Houston, in 1879, who patented and afterwards exhibited in this hall, a gravity form of the Daniell cell, in which the zinc was reduced from its solution, and the copper re-dissolved by the action of charging the cell from a dynamo or other source of electricity. During the last ten years, Chas. F. Brush, of electric-light fame, to whom has finally been awarded (in the highest Court of Appeal) the priority of invention of the modern type of accumulator, M. Fauré and a host of minor inventors have occupied the field with their respective inventions."

From this followed special description and account of the Planté and Fauré batteries, and that the Brush-Fauré, the latter without any electrical or scientific discovery whatever, consists of a patent

on the grid or open-plate mechanical methods of attaching the peroxide of lead to the plates. The words used are :

“Brush patented every conceivable form of plate for retaining the “active material.”

The lecturer also says of the Fauré-Brush plates :

“As this type therefore seems to be the one that will alone survive in the struggle for existence, let us examine its construction “a little more minutely.”

This quotation, which forms the basis of our present remarks, goes to show, as at first claimed, that storage batteries are in the midst of “evolution.”

The remark of Mr. Salom, if true at the time, eleven months ago, is far from true now. Here in San Francisco, where a good deal of attention is being given to storage batteries, the practice, to so call it, does not involve the Brush inventions at all, moreover goes to demonstrate that contrivances for mechanically incorporating the peroxide with the metallic plates leads to imperfect action and lessened efficiency.

The active material, when held in grids, perforations or otherwise mechanically, is exposed on both sides and edges of the cubes or sections. The joints between the lead plate or grid and the peroxide paste are pervious to the electrolyte, and action is set up on all sides.

Present experiments of the Electrical Engineering Company here, one may safely say have advanced beyond the Brush-Fauré plates. The company own and use, for one thing, what is known as the Hatch battery, wherein the active material is held in the separating plates made of tile or other porous inflexible material, and is thus maintained in contact with the plane surfaces of the electrodes. This battery and others of the kind are not mentioned by the lecturer, either because he thought them inferior to the grids, or was not acquainted with the methods.

The nature of the case prevents us from going further at this time with the storage battery problem in this City, but we can assure our readers that the lecture of Mr. Salom would need copious revision to be presented before those concerned in electrical storage here in San Francisco.

The technical part need not be reverted to, it has been gone over hundreds of times, and is an anomaly, in so far as there being from the first, no discovery of new material subject to electrolysis in

the same manner ; indeed the whole art since Planté's discoveries of thirty-four years ago has consisted in the improvement of " methods," and has been, as we may say, a mechanical rather than a scientific problem. It has narrowed down to a contest between weight and capacity, and of the rate of charge and discharge against maintenance.

The lecturer touched very briefly upon the equalization of duty or power in central stations by means of storage cells. There was indeed at that time but little to say in respect to such storage in this country, and we may say there is not much yet, but there is hope and promise of this becoming the chief problem to be dealt with in the near future. It is stated the eight stations in London are equipped with accumulator service.

THE GOTHENBERG LIQUOR LAW.

From some mention of the peculiar system of dealing with the liquor traffic in Gothenberg, and other Scandinavian cities and towns, we have had several requests to state the nature of the laws that bear the above name.

The Reverend W. S. Rainsford, in a late number of the *North American Review*, has given a very clear description of the Gothenberg law, from which we make the following extract :

" In 1866, the town of Gothenberg adopted the system now called by its name. It was that of a limited liability company, pledged to work for the benefit of the public, controlled by the public, and devoting all its surplus profits to the public welfare, after payment of a moderate interest of five per cent. upon the capital of the society. The Municipal Council fixes the number of licenses required to meet the convenience of the public, and grants a monopoly of these to a society formed for the purpose of undertaking the trade, generally for a term of five years at a time. The operations of the society are subject to the control, and its books open to the inspection, of the Council. The statutes, by-laws and regulations, as well as all the appointments in the society's service, must be approved by the Council. The committee of management of the society is formed by a body of representative men, of whom a certain proportion are elected by the share-holders, while the remainder are appointed by the Municipal Council, and may or may not be share-holders ; or may or may not be Municipal Councilors. This system has now been applied to the municipalities in Norway so generally that there are only three small villages, numbering in all a little over 1,200 people, who have not adopted it."

THE REGAN STREET-CAR MOTOR.

In our January issue we mentioned a novel application of gas engines to the propulsion of street cars, by means of a transmitting gearing invented by Mr. D. S. Regan, of this City.

The peculiarity of this gearing is that the motive engine runs all the time at its maximum or some predetermined rate, irrespective of the speed of the car itself, and thus avoids slowing down the engine in ascending grades or other resistance, just when the most power is required. This is a very important matter, the value of which has been demonstrated by trial runs made with a motor fitted up on the Regan system, aggregating 100 miles on one of the City roads, the gas-engine car being put on after the regular traffic had ceased for the night. The trips made, out and back, were 7.6 miles, and the speed for the first night, 6 miles an hour, consuming for the 25 miles, 8 gallons of oil.

On the second night 25 miles were ran at a rate of 7.5 miles an hour, consuming but 7 gallons of oil, the passenger load being sometimes over 30 people. On the third night the speed was 8 miles an hour, and the consumption of oil 6 gallons for 25 miles, and on the fourth night 22 miles with 4 gallons of oil, showing a decrease as the machinery wore loose and was put into adjustment.

Assuming the value of the oil to be ten cents a gallon, or about double the price in the East, the cost of fuel per train mile was in these experiments about 2.8 cents, or at Eastern prices not more than $1\frac{1}{2}$ cents. Mr. Regan, who furnished these particulars, did not conduct but only noted the experiments, and claims that the consumption of fuel and power was not sensibly increased by the passenger loads, amounting sometimes to 32 people, or as many as could find room on the car.

These experiments were made to determine various operative matters, especially the result of the gearing for transmitting the power of the motor. The machinery was constructed by the Union Gas Engine Company, of this City, and the car, locomotive, or whatever it may be called, seems to be one of the first successful applications of the kind, or at least is the only one wherein the maximum power of the engine has been maintained irrespective of speed or resistance, and this we think is an essential condition in many cases.

An engine of this kind is complete within itself, and can be applied on any line, also can be run in conjunction with horses or

any other method of traction on the same line, so that there is no trouble in arriving at the merits of the system, or its expense, because both maintenance and fuel are measurable quantities.

NICARAGUA CANAL.

The following extract is taken from an address by General E. S. Wheeler, Superintendent of the St. Mary Canal Construction Company, delivered in Cleveland, Ohio, in January last.

“At Panama, the length of the canal is 41 miles, and the highest land to be crossed 295 feet. At Nicaragua, the length of the canal is 169 miles, and the highest land necessarily crossed 153 feet, less than some of our tallest pines. Here the isthmus is divided into two parts by Lake Nicaragua. This lake is 110 miles long and 40 miles wide. It is therefore about as large as that part of Lake Erie lying to the eastward of Ashtabula. Its surface is 110 feet above sea level. On account of its size it is not subject to greater fluctuations than Lake Erie. If a strait were opened to it from the ocean, so as to lower it down to sea level, it would still be 130 feet deep. Its bed is not simply a mountain valley, but rather an oceanic depression. On the Pacific side the lake approaches within 12 miles of the sea. The intervening land rises 43 feet above the surface of the lake. In order to permit ships to pass from the Pacific up into Lake Nicaragua, it is only necessary to build six such locks as those at St. Mary's falls, and twelve miles of canal, in which the deepest cutting would be only 43 feet more than the depth of the canal. On the north side the lake is connected with the Atlantic by the San Juan river, which is 120 miles long. In its upper half it is about 10 feet deep, and from 300 to 1,200 feet wide. In order to permit ships to pass from the Atlantic Ocean to Lake Nicaragua it would only be necessary to build six locks similar to those at St. Mary's falls, and construct a canal through the valley of the San Juan river 120 miles long, in which there would be no cutting above the level of the canal. The engineers of the Nicaragua Canal Company show that even this is not necessary, since the water can be turned by a dam into another valley, thus making it a navigable arm of the lake, so that about 100 miles of the route will need no artificial preparation.

About 40 miles more will only need to be deepened by dredging, leaving 26 miles only of canal proper through open cuts. The same company has made an estimate of quantities of work of various kinds necessary to complete the canal. These quantities can be expressed in units familiar to us by the statement that the Nicaragua canal requires about twelve times as much lock building and twenty-five times as much canal excavation as the St. Mary's falls canal. There are also two harbors to be built, one at either end of the canal.”

COMPETITION IN SWEDEN.

When the emoluments of journalism have reached enough to purchase a passage to the Scandinavian countries we think seriously of going there to get rid of competition. It is on all sides, the great fact of our age, contemptible, unnatural, and the cause of the greater part of the dishonesty, which is an inevitable product of commercial competition.

Some learned philosopher defined life as "a struggle for existence." This is true, but the struggle is divided into two classes or kinds, one a struggle with the elements of nature, and the other with our fellow men. In competition each tries to keep his head above water by thrusting some one else's head beneath, in other words, not earning his own bread but snatching the bread of some one else. In this manner is blunted, or stamped out, the traits of kindness, generosity, gratitude, and even humanity. Greed, indifference, dishonesty and cruelty are the results.

The effects of commercial competition were made a study some years ago when the writer was living in Sweden, and enjoyed for a time the luxury of being almost oblivious of such contention and its evils. There was no care about prices, no cheating, no blazing signs or tricks of trade. You could hand over your purse to anyone to take out what was due. This was a common practice until the language was mastered, and not a penny was ever taken beyond the true amount. Cheating was not thought of. Throughout the summer we kept a boat in the center of a compact city of 70,000 people, in a canal traversing the principal street, and never removed guns, fishing tackle, food, or anything else from the boat. The things were as safe there as in the house.

With the good results that arise from a want of competition there is also a humorous side, especially to Americans who are born in an atmosphere of competition and restless struggle to grow, expand and change. A couple of anecdotes will serve to explain what is meant by the humorous side of the Swedish system.

There are famous boot makers there, and a month or so before leaving Gothenberg, one autumn, we called on a boot maker to order a pair or two for use in England. The measure was carefully taken, and written in a book with various notes, and then we asked when the boots would be done. "I cannot tell," said the man, "I have a great many orders in this book." We named two weeks, four

weeks, and six weeks, but it did no good, he said there were other boot makers that might have less orders, and could promise sooner or at a definite time, but he could not, besides he might be ill, or something happen, and then his promise would be broken. We gave it up, and at the end of the month returned to London.

The following spring, about seven months later, a package came to the office one day from Sweden, and on opening it, and studying for a time, the Swedish order for boots came to mind. They were worth waiting for. In a month or two more an account came, and the transaction was completed.

On another occasion a "dingy" was wanted, a small boat to tow behind a small sloop for safety in the squally waters of the coast there, so that in case of a capsizing there would be something to cling to. We called on a well-known builder, or at his "works," where there were two men and a boy at work. The proprietor was at home to drink his four o'clock coffee. Calling at his house the conversation began with an inquiry as to how soon he could prepare a small "dingy." "Det vet jag inte" (that know I not). The same old answer. The same course was followed as in the case of the shoemaker, but with a final declaration that he had doubts of being able to make a boat at all. We ventured the suggestion that he might add more workmen. "More men!" said he, "why I have so much trouble now I can scarcely get home to drink my coffee in peace!"

A natural inference will be that in a country like this there is no progress, and that civilization can only advance with "high pressure." It is not so. There is no country in the world with so few natural resources has raised itself higher in the scale of civilization than Sweden. In manners, customs, dress, education, literature, music, poetry, Sweden holds a first place. The country is well served with railways and canals, one of the latter, the Gotha canal, a stupendous work, cut through granite in many places, 300 miles long, connecting Gothenberg and Stockholm, the Baltic and North Sea.

This canal in one place rises 135 feet, at the great Trollhattan Falls of the Gotha River. Steamers of 1,000 tons, and shipping of all kinds, can be seen climbing and descending the hill through sluices cut out of the solid granite. There are 70 sluices or locks on the line, 35 on each slope. The country's credit is such as to command money at the lowest rate in Europe, and the administration of the Government is the most perfect of our time. So the rule

of "no competition, no progress" does not apply. The solution is not difficult. There are two kinds of competition, or rather there are two causes that prevent it, one is "coöperation, the other "monopoly."

In Sweden the absence of competition, or the small amount of it compared to this country, or to England, is due to coöperation, natural and cheap prices for all commodities, complete care of the indigent and unfortunate, an impartial and inexorable administration of the laws, and homogeneity of the people, the latter a leading cause no doubt.

There is a deep philosophy in competition, if the various conditions covered by that term can be classed under one head. As a matter of fact they cannot. In one sense it means freedom, in another just the opposite. There is, however, one constant characteristic, that of selfishness, and one constant result, the development of dishonesty and savagery too, if we include war, which is often a sequence of competition.

At the late meeting of the American Society of Mechanical Engineers, Mr. Strong, of New York, a well-known steam engineer, claimed that a 1,800 horse power triple compound Corliss steam engine with boilers and accessories, costs about ten times as much as a locomotive of the same power. If this is true, or half true, it raises a problem of much interest. Stationary engines are not better, and commonly not so well made as locomotives are. They have the advantage of resting on permanent foundations instead of jostling about on flexible frames, and are not subjected to various disturbing conditions that call for strong material and good work. The main causes of this wonderful discrepancy must be piston speed and forced draught, but a \$10,000 locomotive doing the work of a \$100,000 stationary engine surpasses belief. There is no doubt that locomotives, not excepting any other form of steam engines, are the most perfect in their adaptation, a fact proved by the uniformity of designs in all countries. No other class of engines have in any degree received the same study and skilled effort.

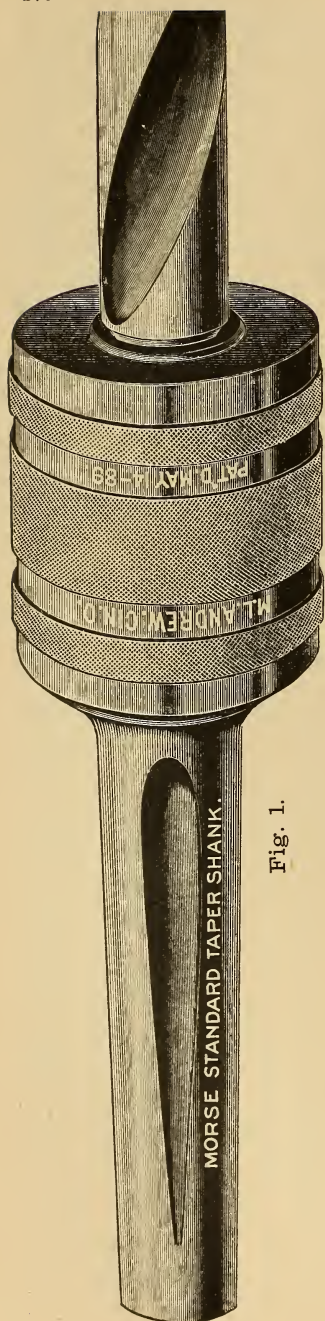


Fig. 1.

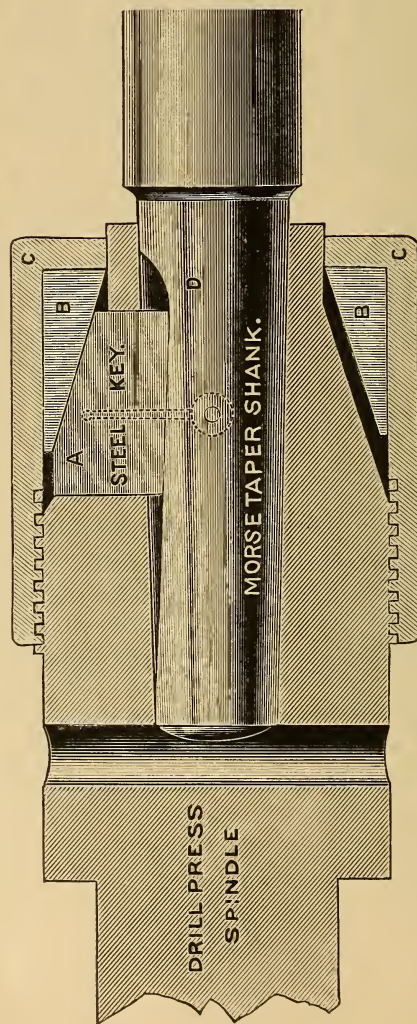


Fig. 2.

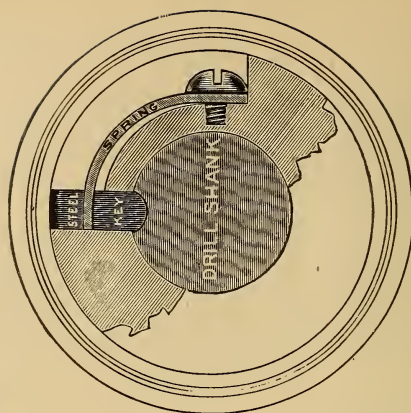


Fig. 3.

IMPROVED TOOL SOCKETS.—M. I. ANDREW & Co., CINCINNATI, OHIO.

IMPROVED TOOL SOCKETS.

M. L. ANDREW & CO., CINCINNATI, OHIO.

Among the various details of shop implements there is perhaps no other that lacks so much of having the desired functions of performance and endurance as sockets to hold drills, augers and other revolving tools. When the strains do not amount to much some forms of gripping chucks answer very well for a time, but they are clumsy and soon wear out.

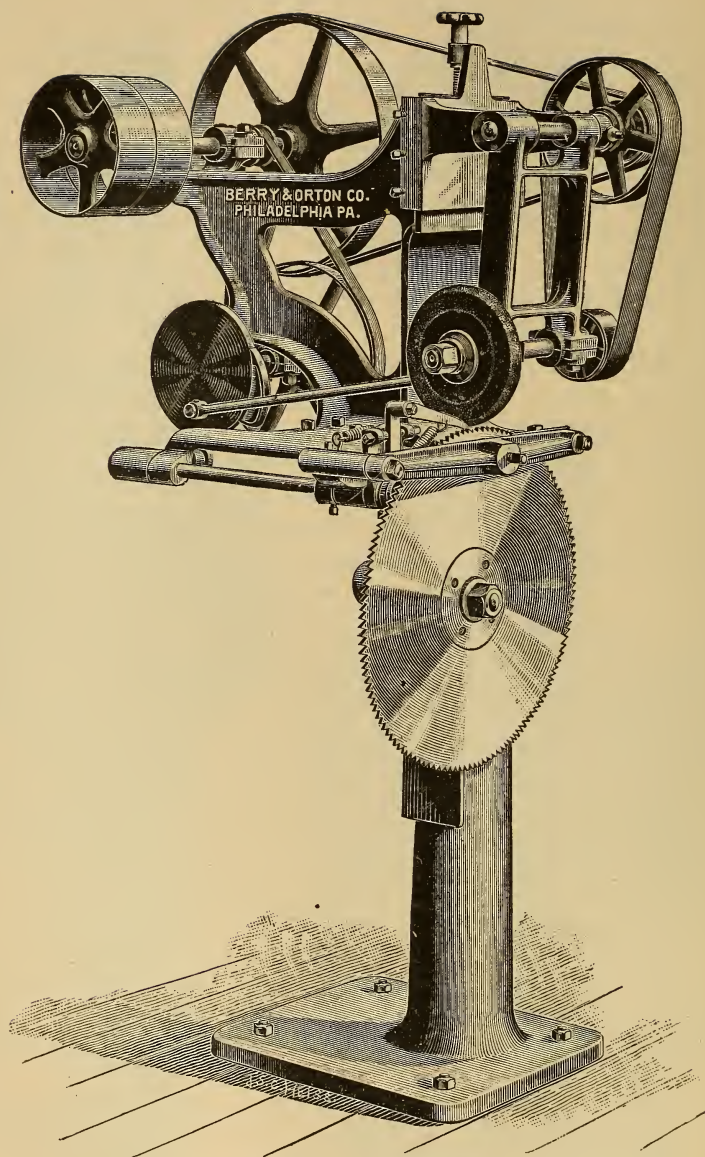
As claimed in a recent number of this Journal, the old square socket is best of all, if it were practicable, which it is not, because neither the socket nor the shanks can be made true without an expense that is prohibitive, and round shanks are indispensable for this reason.

There are three conditions to be filled: a fit or alignment to hold tools true; a detent to prevent turning, strong enough to withstand the strains of the work, and means of ready release when the tools are to be removed. There are, besides, other requirements less important, such as holding the tools from falling out, a diameter not much larger than main spindles, no projecting parts to catch clothing, and endurance.

The first systematic manufacture of tool sockets having the required points, that we know of, has been founded by Messrs. M. L. Andrew & Co., Cincinnati, Ohio. They are made as shown in the drawing opposite, Fig. 1 being a complete socket, Fig. 2 a longitudinal section, and Fig. 3 a cross section. *A* is a hard key or detent, the edge fitting into a groove in the tool shank *D*. A collar nut *C* screws on the end of a spindle or stem, as seen in Fig. 2, and forces inward the beveled collar *B*, which presses in the key *A* like a wedge. The angle on the inner face of the collar *B* is 6 to 10 degrees, so it will release automatically when the collar nut *C* is backed off, and a spring, seen in Fig. 3, withdraws the key, releasing the tool shanks.

The holding power of these sockets is governed by the dimensions of the keys, and as shown are claimed to equal the ultimate torsional strength of the tool shank itself.

The device seems to be neat and efficient, and, as we are informed, has been extensively adopted in machine works at the East. They are cheap in price, neatly made, and fill a real want, especially for drilling machines and the like.



AUTOMATIC SAW-DRESSING MACHINE.

THE BERRY & ORTON CO., PHILADELPHIA, PA.

Saw-sharpening machines operating with grinding wheels have been a subject of copious invention in Europe, especially in England, for the reason, no doubt, that circular saw-benches are much more

extensively employed there than in this country, and the nature of their work demands more careful dressing or sharpening.

The difference between a circular saw that is "round" and sharp, and one that is "ragged" and dull, is so great that no one but a practical sawyer can understand it. A round saw, or one that is true enough so all of its teeth will cut equally, is an exception, and, when filed by hand in the common way, does not exist. By machine sharpening this end is attained, and in a much more rapid manner than by filing, and at much less expense.

Machines for the purpose are much varied in construction, the present being one of the newest and most compact designs that has appeared, and is so well shown in the drawing that description is not required. One difference from most of the European machines is in the grinding wheel moving "across" the saw instead of toward its center, and in the positive crank-motion for operating the wheel, so the machine is wholly automatic, the saw being turned at each stroke by means of a pawl.

These machines are especially useful for iron-cutting saws, one of which is shown on the machine in the drawing. Such saws operate badly and slowly unless perfectly round, and machine-sharpening is almost indispensable. The machine shown will operate on saws to 36 inches diameter, and will sharpen 56 teeth per minute.

GERMAN SKILLED INDUSTRY.

German mechanical industry, especially the making of machines, has been developed with a suddenness that makes it difficult to understand. Most middle-aged people engaged in this business can remember how less than twenty years ago the German people concluded to go into machine making, and built, in the Rhine country and in Saxony, works to produce machine tools, wood-working machinery, and others of the kind. It may also be remembered how in three or four years' time these enterprises, many of them, failed, but the Germans are a persevering people, and understood where failure came from.

They had brought to bear the result of their technical schools, which had been founded long enough then to furnish these workshops with foremen, draughtsmen, clerks, and all kinds of service, except the shop skill of manipulation. In England, on the contrary, what there was of technical training included the shop part,

and without this the other elements proved useless in the German shops.

Then came special efforts to master manual skill or constructive skill, it may be called, and so successfully that no country can now claim an advantage over Germany in good work. The locksmith with his files, soldering iron and hand-lathe tools went out and new processes came in.

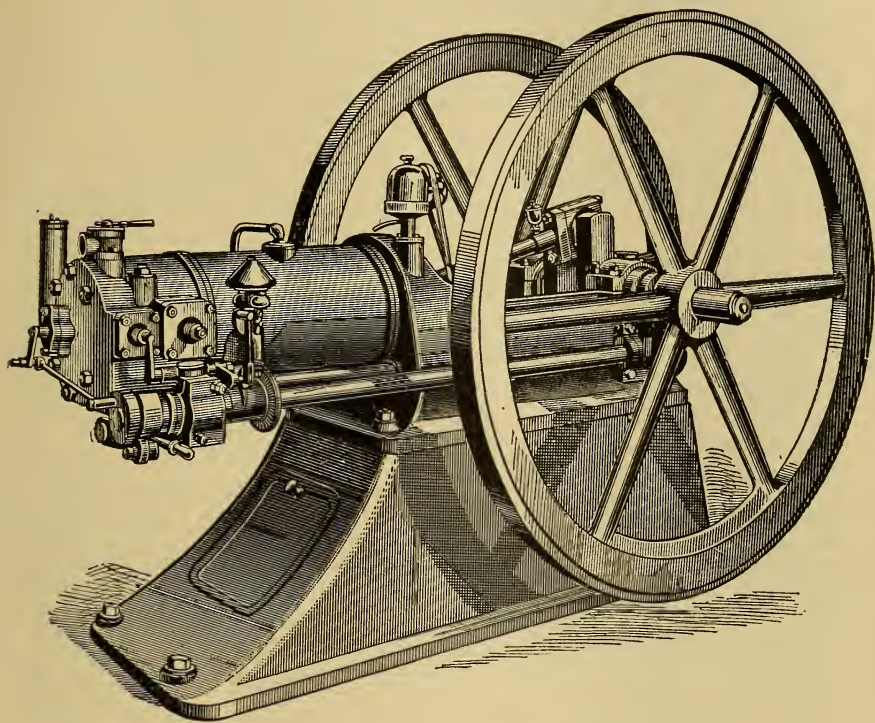
This manual skill having now attained a permanent place in German machine working, other elements, such as scholarship, technical and otherwise, and a knowledge of languages and customs in other countries will give a great advantage over competitors.

The great display at Chicago was supplemented with a kind of syndicate of the machinery makers in Germany, who sent out skilled agents on the general average or joint stock plan, to visit all the various neutral markets of the world and contend for trade.

Consul J. C. Monaghan, at Chemnitz, which is a principal machine-making center in Germany, writes to the Department of State respecting German methods of securing trade, and says of the South and Central American countries :

"If he is so conservative that he wants what his fathers worked with, let us give it to him. He should know what he wants, we should seek to know what that is and furnish it. This is what the Germans intend to do. Let us give the South Americans such shapes as they prefer, but finished as we finish. There is nothing made in England or Germany in the machine or tool line that we cannot make as good or better. If the South American prefers plain to polished, heavy to light, rough to smooth, let him have them. It is much easier to sell a man what he thinks he wants than it is to sell him what we think he ought to buy. That is as true of business in Rio de Janeiro or Buenos Ayres as it is in New York or Boston. It may be possible to reform foreigners up to using our tools, we can never coerce them."

The enhanced value of raw materials and food in Germany, which would otherwise shut out many of their skilled products from neutral markets, is provided for in a good many cases by making the home consumers "foot the bill." There are two prices, one for Germany, and another for export trade. This is a policy or trick, it may be called, that will not last long in Germany, and succeeds now only because such discrimination falls mainly on the agricultural interests, which there, as in other countries, are slow to understand such methods, but, whatever can be said, there is no denying a wonderful activity in the present conduct of German skilled industry.



THE COLUMBIAN OTTO ENGINE.

SLEICHER, SCHUMM & COMPANY, PHILADELPHIA, PA.

Among American exhibitors of machinery at the Columbian Exposition no other firm was placed in such peculiar circumstances as Messrs. Sleicher, Schumm & Co., of Philadelphia, makers of the Otto gas engines in this country. They not only had to maintain the very high standard of their work at home, but had to emulate the parent works at Deutz, in Germany, who sent ten finely-constructed engines, also the French makers at Paris, who sent several engines.

These three works employ collectively 2,000 men, and produce annually 2,500 engines. The works at Manchester, England, must produce at least 2,000 more, so the whole product is 4,500 engines a year, for gas, gasoline and petroleum, these modifications relating only to the methods of supplying or generating the gas.

The modern gas engine, which may be said to have originated with Dr. Nicolaus Otto, has become a great fact in modern industry.

The manufacture of engines is but a trifle when compared to their uses and economies as prime movers. The manufacture was established about twenty years ago, and the total number produced by the various firms making the Otto engines must be 30,000 or more.

One reason for the success of these engines was the high standard of workmanship assumed from the very beginning. The first made in this country for Messrs. Sleicher, Schumm & Co. were constructed at Messrs. Bement & Dougherty's, now Bement, Miles & Co., of Philadelphia, machine-tool makers, where all the precision of these famous works was brought to bear. The editor of this Journal was a fellow-passenger and room mate with Mr. Sleicher when he first came out to this country, and on the journey examined data from the works at Deutz, which was then the most completely-organized establishment of the kind that had come to notice.

These remarks are suggested by the firm sending a drawing of a late design for their standard engines, shown at the head of this article, a new feature of which is the segregation of all parts liable to wear, so they may be replaced if required without delay or much loss. The main thing, however, in a communication sent, is the statement that in this latest design the consumption of gas has been reduced to "fifteen cubic feet per hour" for each indicated horse power. In the American exhibit at Chicago the consumption of gas by the Otto engines was $16\frac{1}{2}$ cubic feet an hour for each horse power. One engine exhibited there was of 120 horse power, and another of 60 horse power.

THE BRITISH BATTLESHIP "RESOLUTION."

The *Resolution*, one of the eight British battleships to be built under the Lord Hamilton appropriation, and the first completed, has undergone a cruise with very unsatisfactory results. The ship is of 14,000 tons burthen, 13,000 horse power, 380 feet long, and 75 feet breadth, a monstrous "battery" protected by armor, and with all the new features and accessories of the time. The *Resolution* started for Gibraltar, met a gale in the Bay of Biscay, where she came near foundering, and returned to England.

The difficulty was in rolling, or want of stability. The Admiral in command claimed that he had never gone through such a terrifying time, and that the ship rolled to 42 degrees in moderate weather.

Engineering, London, attempts a kind of defense of the plans of the *Resolution*, but the fact is, in plain unscientific terms, that in continually raising ship's guns and armor higher and higher above the water, designers have reached a point where the vessels capsize whenever there is opportunity.

The *Resolution*, according to her commander's account of the matter, and he certainly is a good authority, came very near following the *Victoria*, and for the same reason, but under different circumstances.

The radius of fire, as it is called, depends, in the case of a battle at sea, upon the height of the guns above the water line. Raising the guns raises the free board accordingly, and calls for the heaviest armor above water, shortening the metacentric height, or bringing the center of gravity and buoyancy nearer together. If these centers are in the same plane or place there is nothing to hinder a ship from rolling over in smooth water or at her moorings, so the center of buoyancy is raised by adding to the beam, and by disposition of all possible weight below this center, then these conditions are trenched upon by top weight until a narrow factor of safety is reached, and our opinion is that the fated *Victoria* is not the last of the battleships that will become a coffin for their crews.

With all the talent that is devoted to this means of civilized murder and destruction that we call naval armament, there seems to be some fate that prevents exact conclusions. It is true the circumstances are continually changing by reason of new guns, armor, steam power, and other things, but it does seem that stability should be determined, and it is, no doubt, except as to synchronism, that is, the pendulous motion set by rythm of the waves and the roll of a ship. This is, and must remain, an unknown factor. It occurs in factories where hundreds of looms are set on a floor and happen to fall into synchronic motion. The most familiar example is in men marching over a bridge, or a single person walking on a bending plank. If the rolling periods of a vessel follow in some sequence the occurrence of waves, there is set up a movement not amenable to mathematical rules, except that the righting angle is known, but even this may fail from a combination of causes.

FASHION IN STEAM ENGINES.

In *Engineer*, London, there was, some time ago, an article on "Fashion in Steam Engines," in which there was an unflattering criticism of American practice that permits of some reply.

There has been in England, and on the Continent also, profuse copying of American designs for stationary steam engines, especially of the high-speed and Corliss types, which are not only not improved, but in many cases less symmetrical.

For example, copies of the Corliss engine, which are most common, are nearly always of the kind set up on legs and without continuous bolted-down frames, such as the best makers in this country employ, and there is certainly no improvement in this type. High-speed engines also are in many cases copies of American designs, and in these two types at least there is no room for just criticism.

"Fashion" is a flexible term, and when allowance is made for the natural prejudice that exists everywhere in favor of what is familiar, discussion is not likely to lead to any useful result, still there are principles or rules of construction that can be set up as a "standard" even in the fashion or symmetry of engine design.

By such a standard impartial people, if there be any, will certainly accord to American practice a first place for land engines at least, but there is one criticism that is just, that upon the too common custom of laying engines on their sides. There is entirely too much of this here and elsewhere, but the trend is toward vertical designs, not only for causes inherent in their operation but also by the influence of marine design, which is all the time growing stronger.

In this class of engines we think there is no one who is impartial will not concede that while the steeple frame is in the main an English method it has been refined in American practice, perhaps ought to be, under the circumstances, but we have seen no designs in England that in symmetry equal our Lake marine engines, and no stationary engines worked out with the symmetry of Mr. Strong's or Professor Sweet's, especially if in the latter we take into account the resistance of strains.

There is, however, some strange reason that prevents people from adopting the best designs, even if that matter were determinable. Some years ago Mr. Jeremiah Head, an eminent engineer in England, prepared designs for what he called an "ideal engine." The engine was certainly a very perfect one, but no distinctive feature of it whatever passed into practice.

LITERATURE.

A Lecture on Education.

Prof. C. A. Stetefeldt, of this City, who lectured on "Education," at the Stanford University, in December last, has sent us a copy of his lecture, which we have had much pleasure in reading over.

The subject is discursive, and hence is novel. Essays and lectures on "Technical Training" have become so numerous, so nearly alike and uniform, that we skip all matter under that head, and believe everyone else does the same. It is a safe kind of matter to write about; calls only for opinions, and permits one the pleasure of telling other people what to do.

The objective point of the present lecture, aside from suggestions as to methods, is to urge the importance of studying the natural sciences. This is a proposition none the less true, because it is being almost universally acted upon, or indeed has become a necessity, here set forth, however, in several new aspects.

We propose in a future number to print some extracts from the lecture.

The Monist.

OCTOBER, 1893.

Dr. Paul Carus has written for the *Monist*, of which he is the editor, an essay on "The German Universities at the World's Fair," that is the most interesting, and perhaps the most useful, that appears in the last issue of that journal.

The *Monist* is a philosophical quarterly, or to be more exact, a quarterly that is philosophical. The present number contains essays on "The Present State of Mathematics;" "The Correlation of Mental and Physical Powers;" "Heredity and Progress;" "Agnosticism;" "Automatism and Spontaneity;" "The Nervous Center of Flight in Coleoptera;" "Heredity vs. Evolution;" "Sebastion Castellion," and Dr. Carus' article before named. Then follows correspondence, criticisms and reviews, making up an intellectual array that may easily

engage one's thoughts until the next quarterly issue.

We have neither ability nor time to study or deal in a deserving way with most of these learned articles, and much less to write opinions concerning them, but must congratulate Dr. Carus in having here, in a compendious way, told more of the German Universities, their nature, rise and influence, than will be found elsewhere in our language.

We do not, in this remark, mean the laws, constitution and statistics of German Universities, but the spirit of them, and the wonderful results and influences that have arisen out of German learning in the last century. The author closes with a short review of learning in this country that is fair, true and complimentary, except as to our political system and its influences in the present and future in shaping intellectual progress.

The *Monist* appeals to a permanent and increasing class of readers in this and other countries, and represents advanced thought in a field that should engage the attention of serious people. It is published by the Open Court Publishing Co., Chicago, at 50 cents per number, or \$2.00 a year.

Consular Report, No. 160.

JANUARY, 1894.

This number, containing 260 pages, is devoted to packing goods for export. The subject has been continually present for years past, our consuls usually complaining of the manner in which American goods are packed, and English correspondents doing the same. The American consuls contrast the methods here with those of European countries, disparaging the American packing, and praising that of England, Germany and France, and the British consuls claiming, in some cases that we have seen, that their countrymen were careless, and made up awkward packages compared to the Americans.

After reading over this matter for several years past we have reached the conclusion that American packing for neatness and

ingenuity is good, and for strength and safety is bad. Also that our merchants fall into a routine of method, and put up their goods just the same for Cairo, Illinois, as they do for Cairo in Egypt.

We doubt if there has ever been issued a number of the Consular Reports of more value than the present one. The time is easily within view when this country must export a large share of its products, both those of skill and of the land, and one condition of success in this undertaking is an understanding of customs and circumstances in other countries.

One advantage that European countries have over this one at the present time is that goods are sent out of the country by regular "shippers," a business almost unknown in this country, but one that must come in and be learned in good time. At present the makers or producers of goods ship them, or attempt to do so, the same as in domestic trade, but it is quite impossible for any firm to learn the rules and customs of shipping to various countries. It is a trade by itself, not an easy one, but intricate, and calling for a large amount of special knowledge and data, which no mercantile or manufacturing firm is likely to possess.

The charges for shipping are trifling, and there is no loss whatever to manufacturers or producers, who cannot themselves do the work at the same price. We had some experience one time in France, where a well-known manufacturer positively refused to have anything to do with goods after they had left his works, or to even recommend any means of shipment.

From the present volume can be seen what a "shipper" must learn, and if some of our young men who are seeking business opportunities would learn this matter of shipping it would at least lead to lucrative situations if not permanent business.

Annual Report of the Board of Education.

LOS ANGELES, CAL.

We have received the above-named document from the Secretary of the Board, and doubt if any other city of 65,000 inhabitants can show a more extensive or complete department of education.

The enrollment of pupils is 10,998, embracing ages from 5 to 17 years, with an

average daily attendance of 7,818, or more than 75 per cent. The fund provided for the year past was \$310,164.36, of which \$6,516.89 was carried forward as a balance.

There is much in the report of more than local interest, especially the rules of the Board of Education, that should furnish useful suggestion to other cities. One matter of astonishment is the large number of women that are represented among the officers and staff. It calls to mind the Russian adage: "The women educate the children, educate the women." We note the absence of an index, that would have added value, or at least convenience, to the report.

Dynamo and Motor Building.

BY C. D. PARKHURST.

This little work is for the use of amateurs, giving clear and complete instructions for making small electric motors and dynamos for domestic purposes, including both the details of construction, and at the same time instruction in the electric principles involved.

The author must himself be an enthusiastic amateur in electrical matters, as well as a deft mechanic, to venture as he does upon the minutest operations of shop manipulation and tool processes, also the mysteries of winding, which of itself may be said to include the essence of the art.

There have been some previous attempts in the same line, but not many, because the pedantic tendency has been so strong as to lead authors away from the amateur sphere, and thus discourage the reader.

One effect of Mr. Parkhurst's book will be to set hundreds of people, especially students and apprentices, at work making motors and dynamos, and they cannot fail if the instructions here given are followed out.

We have one fault to find, not with the work, but its title. The term "building" hardly applies to such work in this country, and not at all in England, where building denotes a great work, constructed by an accretion of parts, such as bridges, ships and especially buildings. This, however, has nothing to do with the merits of the work, which we heartily commend.

It is published by the W. J. Johnston Co., Times Building, New York, and costs \$1.00.

LOCAL NOTES.

The Trans-Mississippi Congress, held in this City last month, is a fourth or fifth meeting of the kind. It may have the effect of "voicing" public opinion west of the Mississippi, and in that way do some good, but there is also the harm of sectional feeling, of which we have quite enough now. The sense of the meeting, by a majority of one hundred and twenty-nine, favored the National construction of the Nicaragua canal, the minority including, of course, all those interested in any way in the present canal companies. For the rest we do not see anything to be commented upon; in fact subject matter seemed to be lacking, and the paucity of this, dragged in political subjects, with which the Congress professed not to deal. As at first remarked, these meetings are, if necessary, unfortunate as well, and this far do not seem to have brought about any definite good that can be pointed out. One of the main things affecting the Southwestern States, and strongly discussed in former Congresses, was not considered at all, we mean a deep-water harbor on the Gulf of Mexico, a matter that would involve a saving of millions every year.

The paper of Messrs. Hoffmann and Browne, published in the present number, gives more information, and the most exact, that has appeared in respect to drift or gravel mining in California. Mr. Ross. E. Browne has for many years, or, as we may say, for almost the whole of his professional life, made a study of these deep-buried ancient river beds, until in the section of the country exploited, they are to him very much as the streams on the present surface. This knowledge is not local altogether, because the signs and phenomena of the Forest Hill Divide is repeated in other parts of the western slope of the Sierra Range, so that by a study of the geological circumstances, taken in connection with signs on the surface, some remarkably correct conclusions have been arrived at in respect to these ancient channels, buried hundreds, and sometimes thousands, of feet below the present tops of the hills. Mr. Browne has become a kind of engineering wizard, not by means of divining apparatus, but by science and commonsense. Mr. Hoffmann's exact methods are indicated in his paper.

If some public-spirited business men in this City will proceed to erect water power electric plants on Cache Creek, the outlet to Clear Lake, and extend wires to this City, and to other cities within reach, will pay in a reasonable proportion of the capital in cash, and conduct the whole on business principles, the scheme can easily succeed. If, on the other hand, there is secured what is called "franchise," to form a kind of ethereal base on which to "issue bonds," the investment being this and nothing more, it will be easy to reach the common history of many such enterprises on this Coast. The bond business with nothing to bond means a double investment of capital, and the loan of money to people who assume none of the risk. The waters from Clear Lake descend about 1,300 feet, and the distance to San Francisco is about 80 miles. We examined the flow in September last, but had no means of determining the volume, it is more than enough, however, for an enterprise such as above indicated.

The terrible accident that happened on the San Mateo Electric Railway on Jan. 27th last, was a consequence of overloading, a thing not tolerated in any other country, and one that should be stopped at once in this country. There are no brakes or means of traction known that will insure the safety of an overloaded car on a steep grade. The traffic weight on the car that ran away was not less than eight tons, and no provision is made, or likely to be made, to control such a load as this after it is once started on a down grade. "It is commercially impossible," as is a regulation to prevent overloading. It is silly to claim that a limit to the number of passengers carried cannot be enforced here as it is elsewhere, all over the world. It is only a question of earnings, or profits rather, and lack of proper control on the part of authorities. To claim that suburban lines of railway cannot be constructed under restrictions for safety is no argument. Let them remain unconstructed. They are not built for any object but profit in their operation, and it is a light restriction to limit the loads, as is done in the case of steamboats, and for less reason.

The proposals to furnish steam boilers for the New City Hall, in this City, indicates the usual provincial and loose way of proceeding, uncertain as to the public, and annoying to those who bid. Looking at it one way it seems all right that a firm should tender for six different kinds of a plant to generate a certain amount of steam. It

gives every system a chance, but the authorities must in the end select some one among the several methods, and this could be done as well at first as after the bids, if the municipal authorities had any way of understanding steam boilers, and could make out a specification of what was wanted. There is no engineering qualification for such work, and no fund to employ it, so the makers of steam boilers are asked to furnish specifications as well as boilers, and the City thus is supposed to get its technical work done for nothing. A better way would be for the City to prepare plans complete, and then invite bids on such plans. It would save contention, and be much fairer to all concerned.

Among the people who have travelled on the Northern Pacific Railway there are a good many who will feel but little sympathy with its present financial maladies. There seems to be an unusual quantity of mean tricks invented about and along that line, and we imagine that "Jim Hill" discounted that circumstance when he made his 2,000 miles of parallel line. Our own grievance is slight. We once arrived at Seattle, Washington, some hours in advance of the time when the boat was to leave for Victoria, and began a search for the parcels office where some things could be left until that time. There was no such office, or any other office or place to leave anything. To be sure of this circumstance we called on everyone in authority about the pier, and then bribed a porter to let us into the secret, which was that the railway had no interest in the boats, and the idea was to drive people up to the hotels and to patronize hackney coaches. Just now the company are regulating matters by refusing landing at their piers to vessels that do not charge 75 cents fare from Tacoma to Seattle, so the railway rate can be maintained.

The *California Architect* has published some plates of the buildings of the Midwinter Fair that exceed anything done by their Eastern contemporaries during the World's Fair. The work is most creditable, and the pictures in one number worth the subscription for a year. We, in common with all interested in journalism on this Coast, feel a pride in the *Architect*. It is made up in a manner that blends taste with the utilitarian in an art that more than any other depends upon an interchange of ideas and thought in an art that is universal, and for that reason, one that restrains the selfish idea of exclusiveness, widens views, and leads to a higher civilization. It

is, moreover, marching with rapid strides into the field of computable quantities. The taste that provides external grace remains, but added to this comes the internal engineering problems of electrical apparatus, elevators, provision for steam power, general heating, with many other elements added in the last few years.

A land slide at Sausalito, in Marin County, on the 20th of January last, caused a good deal of damage, carrying away some houses and sweeping out a cañon for a quarter of a mile below. The circumstances were peculiar, and may not have a parallel once in a century. In a large circular basin, several hundred feet in diameter, forming the head of a cañon, about 200 feet above the ocean, the land had by reason of clay strata beneath started and subsided in terraces. A short distance below the cañon narrowed to a gorge of not more than 40 feet in width, with heavy timber on each side. The broken earth started and formed a dam at this narrow point in the cañon, the water filling in behind until the dam gave way, and the result was the same as in the case of an ordinary dam breaking and discharging a flood of water in a mass. The catchment area of the cañon is not more than half a square mile, and is much less than that of adjacent valleys in which there was no damage done by water. It was an unusual circumstance, and one that no person could have conjectured or foreseen.

COMMENTS.

Two items of news, near together, in a late number of the *Railway Review* furnish a subject for thought. First,—the great steel plant of the Ohio Steel Co., at Youngstown, is nearing completion. It covers between three and four hundred acres, and will give employment to thousands of men. Second,—the Bethlehem Iron Works have closed down for want of orders, throwing a thousand men out of employment. These are not alone. There are many more of the same kind both ways, and the only logical inference is that under the stress of home competition the agencies of production need not now depend upon a market so much as the power of crushers, competitors. The war has passed through two phases, one a

high tariff, next combination, and now comes concentration, which means an internecine war between producers. This was foreshadowed in the movements of the Carnagie interests at Pittsburg, and almost boldly avowed in Mr. Carnagie's late manifesto. Of the three methods the last is better for consumers, and thus some progress is being made.

The Canadian Society of Civil Engineers propose to adopt a close corporation, that is to compel all practicing engineers to become members of their Society, also to prevent Provincial and Dominion land surveyors from practicing as civil engineers. After such views and such a spirit among one of the learned professions can anyone find fault with trade unions among workmen, or "protection" among manufacturers? In "the struggle for existence," as Malthus calls it, the judgment is always swayed by personal interests, and we do not wonder at such a scheme among engineers as a business expedient, but men whose business is mainly computing should soon arrive at the utter futility of such a course at this day. To begin with, the term engineer is too indefinite to classify men, and their qualifications too diversified to be covered by any one name, and there are no possible standards that a trade mark of "engineer" can be based upon. An examination of the history of eminent engineers will show that any qualification that could have been determined by rules, or by an examination, formed an unimportant part in the faculties and powers that led to success.

If those who rave over the restoration of the Queen in the Hawaiian Islands, and depend on newspapers for their opinions, will invest 25 cents in the *Forum* for February and read an article on this subject by Prof. James Schouler, lecturer on political history and constitutional law at Johns Hopkins University, they will be able to arrive at some of the ethics of the matter. Of all silly literature that has ever been put out through the press, this Hawaiian matter is chief. The main animus seems to come from partisan politics, and a desire to disparage those who dare to rise above the plane of selfish interests. Public acts are confounded with personal desires, and the government is spoken of as acting from personal motives, the same as though it were an autocracy. The reasons, pro and con, for maintaining, or not maintaining, this or that government

are either expedient or selfish. The noble record of our former diplomacy, for generations past, is now lowered to the plane of practical politics, and the truth is not wanted. Prof. Schouler does not discuss the subject on such grounds; if he did, his paper would have but little value.

To a person who has given some study to theories of taxation, and the economics of trade, there is much amusement at this time in watching the arguments for the retention of high duties on imports. Some of these are honest convictions, and some are not. In a late number of the Bulletin of the American Iron and Steel Association there is the following in respect to the steel-rail combination.

"We again state explicitly that there never has been in this country a combination, or trust, or pool of steel-rail manufacturers which was organized to advance the price of steel rails. There is no such combination, or pool, or trust today. There has existed since August, 1887, however, an organization known as the Rail Makers' Association, *the avowed object of which is to equitably allot among the steel-rail manufacturers the tonnage of steel rails annually required by the railroad companies.* There is nothing wrong in this object."

The italics we have added. Who can after that say there is no magnanimity in trade? But the question is, who is this written for?

Two of the most quiet and orderly countries in the world, Belgium and Switzerland, have gone on educating and improving their people in a very successful way, and now the people are about to return the compliment and educate the Government, and so successfully, no doubt, that we will see in these countries, in the near future, purer and better administration than anywhere else in Europe. The *initiative* and the *referendum*, as the Swiss innovations are called, is in short legislation springing from the people, and a *plebiscite* on important measures. In Belgium, where general suffrage has lately been accorded, and where it may be safely accorded if anywhere, it is now proposed that voting be done preferentially or proportionally, each voter voting for such candidates as he may prefer among a large number from all parties, or if but one is to be elected for each office, indicate his relative choice by numerals set opposite the names of the candidates in the manner that the trustees of the Mechanics' Institute in this City were voted for in the last election.

It is trusted that in the interest of the irrigation movements of our time, the people and promoters will let the National Treasury alone. Nearly every movement of importance contains in some way, covert or open, some hint or claim relating to "public aid," which must in the end go to private interests. This is the one great evil of a representative system of government, in which every legislator represents "something" other than the whole country, commonly his friends and a district, not forgetting himself. There may be problems in the conservation and distribution of water that calls for some function of the General Government, as in the case of rivers flowing through two or more States, but it is hard to see how such function can take any form affecting values and be impartial. The distinction between "private" and "public" measures should be more clearly drawn in Congressional bills.

On all sides come signs that the diversion of the earnings of labor and human effort to war armaments and private ends has reached its culminating point. The first symptoms are anarchy, discontent and attempted physical retribution, but these need not be feared, or at least these are not the forces that will cause a halt. Sober judgment, and what is left of moral forces, will soon begin to act. Italy has gone farthest in devouring the substance of her people in war machinery, and the idleness of soldiery. The public debt is over two thousand million dollars; in twenty-five years it increased over one thousand millions. The Latin Union provides that when any of the countries of the Union hold silver of another country, payment in gold may be demanded therefor, and all that Italy now lacks of bankruptcy is such a demand from France. She has a fine stock of war steamers that have never been needed, and have always been a menace to her peace, but these are of no use now. A country like this, the most gifted by nature of any in the world, led to such a state by morbid emulation calls for some drastic treatment of the governing power there.

The railway journals with all their ability, and it is of a high order, have no end of trouble in maintaining the "ethics of the interest." How to show that railway corporations are law abiding, and at the same time set at defiance any statute they consider inimical, is a problem. The Inter-State Commerce Act is a case in point. The absence of convictions and punishments under this law is

sufficient evidence of how impotent the civil powers have become. The law itself, and all other laws to fix prices and values, are failures, we came near saying nonsense, in so far as attaining their purpose in any useful manner, even when dealing with firms or individuals, and still more so in the case of railways, consolidated and so vast that Congress and legislatures have practically no power to enforce laws that interfere with their interests. Still there is hope so long as the subject is conceded as having an ethical side at all, a matter one is sometimes led to doubt.

In our January number we mentioned the Correspondence School or schools founded by the *Colliery Engineer*, at Scranton, Pa. Since then we have received bulletins of two sections of this novel institution, and while we do not feel competent to form an opinion as to what may be accomplished in ultimate efficiency, there is certainly the claim that it will set hundreds at work for themselves, who would otherwise never search or think. This is much more than any other educational system can pretend, beyond a limited enrolment of students. We are not sure but it is the only correct system of them all. Technical training, and indeed all training, is "self work." A college and professors are only aids. The laboratory is, in the case of these correspondence learners, advantageously substituted by the real workshop, and for anyone with natural capacity and a fair environment there is no reason why the correspondence system should not succeed if there is maintained, as there seems to be, an able faculty at headquarters. We will go farther than this, and say that this is possibly the forerunner of an universal method of certain kinds of education.

ENGINEERING NOTES.

Mr. E. B. Ellington, engineer of the London Hydraulic Company, that supplies water under high pressure for various uses, in a recent paper presented before the Institution of Civil Engineers, estimates that an efficiency of 66 per cent. of the hydraulic energy can be converted to electric energy by Pelton Water Wheels, acting under a pressure of 700 pounds per inch. The Company here sent out some wheels for experiment in the London system, but not, as

we imagine, so completely adapted as they might now be made for this particular purpose, or for high pressure and small power. It seems strange that pistons and reciprocating motion and apparatus has not to a greater extent been supplanted by the more simple tangential wheels, that cost less, do not wear out and are available over a wide range of purposes. In some cases reciprocating water engines are employed to produce rotary motion, which is an absurd method mechanically.

There is an old rule, or rules we may say, respecting the thickness of a screw nut, the strength of which will equal that of a bolt to which the nut is applied. These rules vary from half the diameter of the bolt to the whole diameter for the thickness of nuts, and seem to be a fallacy in the fact that the tensile strength of bolts increases as the square of their diameter, but no one has proved that the strength of nuts increases in the same proportion or in any proportion not depending on a number of conditions that do not apply to the bolts at all. The angle and fit of the screw-thread and the elastic quality of the bolts have to be taken into account as well as their reduced diameter, but the main point of all is that notwithstanding numerous tables and rules, no one has ever had much confidence in them. At the Engineers' Club in Philadelphia, there was recently some remarks on stay bolts, and a new equation submitted, calling for increased depth of nuts.

We have many a time wondered what a maker of stationary engines would think if some one ordered an engine to run at a piston speed of 1,000 feet per minute, exposed to the weather and dust, fastened to a "basket frame" and to be jerked about, jarred and generally shook up when under its severest duty. A locomotive by any fair standard of comparison, is the most wonderful machine ever produced by the cunning of human skill, inferentially impossible, but an accomplished fact. The space occupied by a locomotive engine of a given horse power is not one fourth what is required for a stationary engine of like power, and with all its details, including brake apparatus even, is not one half as much. There is a fertile and neglected field of inquiry here for students in steam engineering, one that in itself may not lead to discovery, but certainly to a great deal of suggestion. The improvements of the last twenty years in

marine engines, many of them bear analogy to locomotive practice, so also do all the modern high speed stationary engines.

Tangential or jet water wheels seem to be too much of a problem for our friends in the Eastern States. They have been inventing jet motors for ten years past and seem about as far away from any proper understanding of them as at the beginning. The last one we have seen consists of a series of concave or circular dishes like the halves of a coconut shell, fastened alternately on each side of a plate or wheel. This wheel it is claimed gives "unlimited power" and it might under some circumstances, but not nearly so much in proportion to the water consumed as a more perfect one will. A circular or hemispherical bucket receiving water over its edge at one side, is not a very good one, because the curve followed by the water is incorrect and the surface so great as to cause considerable loss by friction. The alternate positions of the buckets on the two sides of the wheel is an old invention here in California.

The National Tube Works at Pittsburgh, have built a new Bessemer plant in which to produce their own stock. This and other instances of the kind, means that makers of Bessemer steel must in future be restricted to a very low margin of profit. We have in this country from one third to one half more steel producing facilities than are required, and it is typical of the whole iron interest. The want of other avenues for investments, such as would send our products out of the country, has forced an expansion of railways and home industries away beyond a reasonable point and rendered them unprofitable. The craze to grow, expand and absorb the "riff-raff" of Europe into our population, has gone to the point of deranging all the industries of the country, and is responsible in a large degree for the present state of business. The National Tube Works have narrowed their profits until nothing is left for the Bessemer steel makers, and to exist, the tube works must begin at the ore.

Among what may be called mechanical fallacies is "adhesion" of ropes, bands or other tractive apparatus for transmission. Adhesion instead of being a virtue is commonly a vice, lessening first cost

at a loss of double as much in maintenance. There is no lack of tractive force, in fact, there is too much of it in most driving gearing and we recommend that when an agent comes around to explain what a high duty he can attain with a rope or how much the driving power of a band can be increased, the safest way is to place no confidence in such schemes and have nothing to do with them. If ropes slip, more ropes are needed, if belts slip they are too narrow. If a shaft is required to perform a certain work, we provide one at least three times as large as the torsional strain demands; a wide factor of efficiency is provided in wheel teeth, beams, framing, indeed in nearly all the elements of machinery until we come to belts and ropes for transmission. These are commonly strained to their full capacity, hence the demand for increasing "adhesion."

The term nominal horse power, yet employed to some extent in England, is a measure of dimensions in engines, that is, the cubic capacity of cylinders and corresponding proportions of a steam engine. For example, one rule is: A cubic foot of water, a square yard of heating surface, a square foot of grate surface and a cubic yard of boiler capacity for each nominal horse power. Of course these estimates are conditional, depending on various circumstances, but are approximately uniform when the same kind of fuel and the same sort of boilers are employed. Another old rule relating to boilers is to multiply the length of common flue boilers by their diameter in feet and divide by six for nominal horse power. People often make sport of nominal horse power, and claim it is meaningless, which may be true in a scientific sense. It determines the "size" of engines, and the most common method of describing engines at this day, is to name the bore and stroke which, in a commercial sense, is the same thing as rating by nominal horse power.

The Westinghouse compound engines, at Chicago, single and double acting of various sizes from 125 to 1,000 horse power, in all 14 engines, aggregating 7,695 horse power, was a very remarkable part of the machinery exhibit. One of the 125 horse power engines, connected direct to a dynamo, was started on a test run and made 75,000,000 revolutions without stopping. The rate was 5 revolutions per second, 300 per minute, or 1,800 an hour, which divided into the total gives about $173\frac{1}{2}$ days of 24 hours. The engine

was not stopped during this time, as we are informed from a foreign account not likely to be prejudiced in favor of the engines. The engine was of course single acting, otherwise the bearings could not have been maintained for such a run even if other parts could have endured the service. In an early number of this Journal we pointed out that in visiting electric stations in the Eastern States we found but one attendant at stations where single acting engines were employed, no matter what number of engines were in use, while the double acting engines required at least one attendant for each two.

The following is a rule for rope gearing when independent ropes are employed :

$$P = \frac{C V N}{4000} \quad C = \sqrt{\frac{4000 P}{V N}}$$

When V = velocity in feet per minute, N = the number of ropes less one, C = circumference of the ropes in inches, and P = horse power. The number of ropes is taken less one, so as to provide for repairing or renewing a rope when necessary. For long and reliable service a number of independent cotton ropes is perhaps the best of all among the various methods of transmission from engines or other prime movers. This method has succeeded tooth-gear wheels in many cases in England, and has stood the test of "survival" everywhere. Here in this City, there are a number of these rope-gearing transmissions that have given all possible satisfaction. A good set of cotton ropes will last eight to ten years, and there is no danger of accident as when single ropes are used for first movers. The ropes on the Union Iron Works' main engines in this City have been in use eight years.

The Edison Electric Company, of New York, have put into use a new steam engine of 2,500 horse power, that for anything that appears in the drawings, is as well adapted to driving a steamship as a dynamo. The gradual trend of stationary-engine practice to the marine type is becoming more and more apparant. The engines last erected in this City by the Edison Company are essentially marine in all leading features. It is true the circumstances of driving large dynamos directly, favor this type, because analogous to operating propellers, but this has not much to do with the matter ; the common means of transmission apply to all kinds of engines alike. In the

case above first mentioned the engines are quadruple expanding with cylinders 26, 37, 52 and 72 inches in diameter, with a stroke of 36 inches, to operate with an initial pressure of 200 pounds to an inch. In one particular, the shortness of the connecting rods, we think the engine is too much "marine."

ELECTRICITY.

NOTES.

The Westinghouse Electric Company have constructed two dynamos for the Louisville Gas Company, each to supply 9,000 lamps. The weight of each machine is 50 tons, the armature being 12 feet in diameter. These are claimed to be the largest dynamos made to this time, and are, no doubt, if the Ferranti machines are not counted, and these we believe were never completed. The Niagara dynamos will be immensely larger, and the change from "toy machinery," as electrical apparatus might have been called some years ago, to the present massive structures is the reason for the Westinghouse Company building and equipping new works now in process. The environment of the company becomes more of an advantage as the work grows massive. The cheap coal and iron of Pittsburg, with still cheaper river transport through the Mississippi Valley, are much in favor of this company, so also the fact of their making their own steam engines.

A press correspondent, writing from Great Falls, Montana, gives the following account of electric apparatus there :

"At Black Eagle Falls, three miles above the town, an immense dam has been built across the Missouri River, and hydraulic works and power houses erected. Not only are the street cars propelled and lighted by electricity from the power houses, but they are heated as well by electric radiators placed in each car. Elevators, printing presses, cranes, and all kinds of machinery are operated by the ubiquitous force. There are automatic excavators, electric pumps, and electric rock crushers. A not uncommon sight on the streets is a mortar mixer attached to an electric wire leading down from a pole. The restaurants cook by electricity, the butcher employs it to chop his sausage and Hamburger steak, and the grocer to grind his coffee, and so likewise does the tailor heat his goose. The subtle fluid is a welcome blessing in every home, the house-

wives run their sewing machines and heat their smoothing irons by electricity ; they bake their cakes in wooden electric cake ovens that can be set away on a shelf like pasteboard boxes. They have electric boilers and broilers and tea kettles. What a singular anomaly when one pauses to think of it, that of broiling steaks and heating smoothing irons through the instrumentality of a waterfall."

A writer in *Electricity*, London, furnishes a witty and true criticism of the strained efforts of the time to apply mathematics to electrical matters. We make room for a short extract :

"A distinction should be observed between accuracy of elementary knowledge and higher theoretical attainments. It is important that every engineer should have exact and clear ideas as to the relations between force, power, work, and energy, and the electrical engineer must be familiar with other electrical relations. These elementary laws have an apparent connection with mathematics, because mathematicians have defined them, But the mathematics of Ohm's law go no farther than the rule of three. If some of the simple facts of engineering and of electrical science could be divested of the mathematical garb in which professors delight to clothe them, the beginner would advance with much less hesitation. He is too often presented with a fact swathed in algebraical attire, bound with many a hard and knotted formula, and decked with streaming expanded terms, tasseled at the end with '+ etc.' He ultimately makes acquaintance with the fact itself, and this acquaintance continues long after the mathematical millinery has been discarded by the mind."

MISCELLANEOUS NOTES.

A good many years ago when we had occasion to visit British ship-building yards, the prediction was ventured that Harlan & Wolff, at Belfast, would become principal among the various firms. This idea was based mainly upon "order" in their works. Everything had a place and was in its place, there were no piles of scrap or lumber of any kind lying around. That was many years ago, sixteen or more, but the prediction has come true. For three years past the Belfast yard has turned out the largest amount of tonnage of any ship-building yard in the world. Last year the output was 65,660 tons; the year before, 68,612 tons. Next followed Gray & Co., 59,810 tons, and Russell & Co., 54,240 tons. The two last-named firms are at West Hartlepool and Port Glasgow.

The Tacony, Pa., Iron and Metal Company have constructed for the U. S. Government two lighthouses of iron, 175 feet high to the lanterns, that by any standard we can discover are far superior to any work of the kind built in masonry. It is singular that such a construction did not follow as soon as iron was available for the purpose in the form of beams and rods, because of its superior strength and open form that permits the water to pass through the frame without impingement. In the center of the structures above named, which are 53 feet in diameter at the base, there is a core tube of cast iron, 9 feet in diameter, within which is a spiral stairway and an elevator. This constitutes the lighthouse proper, or the operative part, the outlying framework acting as a support to this central column. This frame of light columns, diagonally braced, tapers up to a first floor under the service room, about 16 feet in diameter. The structure is complete in appearance and strength, apparently just what is wanted, but a little late in appearance.

In some recent changes in the "Rules of Practice" for the U. S. Patent Office, rule 64 has been repealed. It reads as follows :

"The first step in the examination of an application will be to determine whether it is, in all respects, in proper form. If, however, the objections as to form are not vital, the examiner shall proceed to the consideration of the application on its merits, and in such case he must, if possible, in his first letter to the applicant state all his objections, whether formal or otherwise, and until the formal objections are disposed of, further action will not be taken upon the merits without the order of the Commissioner."

Instead of this the following rule has been adopted :

"Where the specifications and claims are such that the invention may be understood, the examination of a complete application and the action thereon will be directed throughout to the merits, but in each letter the examiner shall state or refer to all his objections. Only in cases presenting patentable substance will requirements in matters of form be insisted on."

The last clause of this rule will avoid one annoying circumstance that sometimes happens when an applicant has to correct or substitute his specification or drawings, or both, because they are informal and then is informed that his case is rejected. The meaning of the rule is that unless a patent is allowed, informality makes no difference, but it also admits of another construction, which is, that informality may be made a grounds for rejection. The first clause seems to pro-

vide for this, but, as we understand it, may permit examiners to include informality among their reasons for rejecting a case. He will certainly be influenced to some extent in forming his views of a badly-presented case.

The *Engineer*, London, has been doing some figuring on the Chicago Exhibition, which if correct, must bring that enterprise among the many causes that have produced hard times. The stockholders, it is claimed, "may get back 15 per cent. of their investment." The sum of \$200,000 was paid for the use of Jackson Park, which is probably worth more now than it was before. This the *Engineer* considers a waste, and goes over some of the item of expense, such as "national agitation," \$65,203; secret service, \$118,600. Souvenir coins cost \$1,988,775, of which \$165,000 remain unsold, and expenses are debited with \$127,000 on account of these coins. The total outlay on the part of the management was \$42,612,195, and receipts \$29,112,195. leaving a loss of more than \$13,000,000. The total admissions were 27,539,521, of which 6,059,380 were free. At Paris in 1889 the admissions were nearly the same, 28,149,355. These figures seem to have been taken from a report by the British consul at Chicago.

We recently heard a commercial dialogue of which the following is a digest :

A.—"I wonder how Expansion & Co. came to fail?"

B.—"Came to fail! How could they help it? Three partners had \$60,000 of capital in the business. Good earnings for this in a mercantile business is 8 per cent. a year, that makes \$4,200, or \$1,400 a year for each partner. Instead of this they each drew out \$1,000 a month, \$12,000 a year, or for all \$36,000 a year, just \$31,800 more than the business could stand."

A.—"But they had a much larger capital in use."

B.—"Yes, someone else's capital, which they could not borrow at less than 7 per cent., and that is, as I said, as much as they can make in straight commercial business these times. E. & Co. should have consumed their capital in twenty-three months by their extravagant living. Not fail! How would they help it?"

This we suspect is a true picture of a good many firms doing commercial business these times. They eat up their own capital, and that of as many of their friends as will trust them.

A cliff on the Hudson River palisades was recently blown off with a charge of 4,000 pounds of dynamite, which is, no doubt, the heaviest blast ever made for such a purpose. It falls far short of our protechnic efforts out here on this Coast, where about ten times the quantity of dynamite was accidentally exploded on the Contra Costa shore in 1891, but the case is different. The Hudson River blast did no harm, on the contrary was an expedient to remove an intercepting promontory that spoiled the view, and was to bring down enough to last a quarry for ten years to come. The face of the cliff is 350 feet high, and the amount of stone brought down is estimated at 100,000 tons. The engineer and workmen, it is said, remained within 300 feet of the cliff when the charge was fired.

The *Age of Steel* publishes a flattering account of the profits made off sugar lands in Louisiana, showing how a clear profit of \$56 to \$58 per acre was realized in the Lafourche and Terrebonne districts last year. This may be true of last year, but not true of all years, and is largely bounty. The product in the districts above named was 2,080 pounds of sugar per acre, on which the premium would be over \$40, and the real profits \$16 to \$18 an acre. The fact is that the sugar industry of Louisiana is not profitable and never can be, farther than it is supported by some kind of tax. Cane fields that have to be planted each year cannot contend with those planted once in four years, as in Cuba and other sugar-producing countries; besides, the taxes of maintenance due to embankments, and the risk of the river plantations, will always discount the profits over a long period, and thus keep the land at a low value in proportion to its richness and apparent worth.

It is a curious fact, now proved, that all gases are but expanded liquids. We see water melt from its crystalline state of ice at 32 degrees, and pass into a gas at 212. Quicksilver is a fixed metal at 39 degrees below zero, and iron melts at 2,500 degrees above. Gases, which for all time past have been considered permanent, it is now discovered solidify or turn to their liquid form under pressure, and when their temperature is at the same time lowered, for example, if the atmosphere, or its constituent gases, are reduced to about 200 degrees below zero, and is submitted to a pressure of 500 pounds to the square inch, they become liquids. Such low temperatures are

produced by the resources of a modern laboratory, and, of course, until that was possible, true constitution or qualities of gas could not be proved. It might be inferred that by this means organic matter could be destroyed, but "microbes" and seeds both live after being subjected to — 180 degrees centigrade.

The *Columbia*, U. S. war cruiser, if it finally attains the computed conditions under which the vessel is to be constructed, will be the most remarkable one ever built. The cost will be about \$3,500,000, and the greatest compared to tonnage of any of the war fleet as now constructed or planned. The engines are 22,000 horse power, operating independently three screws, two of which can be detached so the vessel can steam with the center one alone at the rate of 15 knots an hour, and with all together 23 knots an hour. The coal bunkers will contain over 2,000 tons of coal, enough to steam 105 days at a speed of 10 knots an hour. There are eight main boilers, six of which are $15\frac{1}{2}$ feet diameter and $21\frac{1}{4}$ feet long, and the other two $11\frac{2}{3}$ feet diameter, $18\frac{2}{3}$ feet long. Besides these there are two auxiliary boilers $10 \times 8\frac{1}{2}$ feet, all being constructed to stand a pressure of 160 pounds. The three sets of triple-expansion engines have each cylinders 42, 59 and 92 inches diameter, 42 inches stroke. This cruiser is called a commerce destroyer, a purpose let us hope she will never be called upon to fulfill.



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A DEFECTIVE PATENT SPECIFICATION.

It is a common thing for patent agents to proclaim the importance of carefully draughting patent specifications, and such matter is commonly set down as for "trade purposes" and to secure business. It may be in most cases, but that does not effect the truth of the general proposition, and now that a learned judge in one of the principal courts in England has taken up the subject, patent solicitors need not farther trouble themselves in the matter, especially as none of them have ever succeeded in so completely showing the result of defective work and procedure.

The case alluded to is that of *Allen vs. Duckett & Son*, tried before Justice Hawkins, in London, for infringement by the defendants, of a soil basin on which Mr. Allen had a patent, or thought he had. As the learned judge's remarks are as entertaining and instructive as they are exceptional in connection with the gravity of an English court, we reproduce the main portion for our readers. He said in respect to the specification of Allen :

"The complete specification really is but little more than the provisional specification. It practically gives no further information. It alleges that it is an improved form, that is, following the description of the invention as stated in the provisional specification. Then the plaintiff says : 'I, William Thomas Allen, declare the nature of this

invention, and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement: It consists of an earthenware pipe of any required section divided into three parts,' exactly as in the provisional specification. Then he says 'two of which contain air chambers marked *AA*' on certain figures which are on the complete specification, 'and flues marked *BB*,' which are upon the figures, 'leading to a ventilating shaft marked *CC*'—all that description is utterly immaterial to the present case—'and the remaining part marked *DD*,' which I do not find at all upon the figures, 'forms a chamber for the excreta to pass through from the closet seat to the main drain.' There is no figure marked *DD*, and even if I could say that one *D* was to be found on one figure, and another *D* on another, there is a little ambiguity about this part of the case, because there are three *D*'s, and I do not know to which two it applies. That is merely a minute criticism of it, but there it is. 'Fig. 1 in annexed drawings is a plan of the basin and pipe horizontally fixed.' This gives me absolutely no information whatever. It is about as rough a figure as one can very well imagine. It shows literally nothing, except what purports to be the interior of the basin with an elongated opening denoted by two parallel lines running from one end of the basin to the other, but I can get no other information from it. 'Fig. 2 is a side elevation of the basin and pipe.' That is absolutely useless for the purpose of showing what is claimed. 'Fig. 3, longitudinal section of the basin and pipe.' That does show, it is true, a basin with the sloping sides, but that does not show the opening itself. Figures 4 and 5 are very much the same thing, and Fig. 6 gives no information of any sort or kind. The patentee goes on to say: 'Having now particularly described and ascertained the nature of my said invention, and in what manner the same is to be performed, I declare that what I claim is (1) the use of a basin and pipe of the above form, constructed of earthen ware or other suitable material, and I also claim (2) the combination of the same with air chambers and ventilating shaft for use in self-flushing water closets or otherwise.' I have already said that the claim for the combination is not made the subject of the present action, and therefore all I have to ask myself is whether the claim for the use of the basin and pipe 'of the above form' is a sufficient description of the invention to satisfy the requirements of the statute. I am of opinion that it is not. Looking at this description and looking at these figures, I fail absolutely to be able to appreciate what was the invention therein which is said to have been the invention. I fail to see it. I do discover from the evidence, what is totally a different thing, that what he claims is a basin with sloping sides. I do discover from the figure that there is to be an opening, a hole, at the bottom of the basin, but there certainly is no novelty in having a hole in the bottom of the basin of a water closet, nor is there any novelty at all in having sloping sides, that is perfectly certain.

Well, then it is said, 'Oh, but you must look at this Fig. 1,' and looking at Fig. 1, I really will not say what it is like, because I cannot tell, but I do know that it gives me not the smallest intimation of the object of the invention, or what this invention is supposed to carry out. We were told in evidence that the object was to have an opening at the bottom communicating with the drain below, which is intended to carry off the soil. We were told, moreover, that it was to present this form of opening, and the hole was to be of such dimensions as to prevent the possibility of a dead cat being thrown through it, or an old jacket, or a pair of boots, or something of that sort. Of course, whether it would prevent the cat, or the old boots, or the jacket going through would depend very much indeed on the size of the cat, the boots and the jacket. An old tom-cat who died in agony, with his tail spread out and his legs also, would probably find a difficulty in getting through a hole $2\frac{1}{2}$ inches wide; a little kitten just born would probably find no difficulty in it. So a child's boots would find no difficulty in getting into the drain if they were thrown down the water closet, nor would probably a little jacket such as some babies do wear, and, probably, will continue to wear, so long as there are babies to go on wearing them.

Speaking seriously, can anybody reading this specification form any judgment as to what the object of this invention is? If it is said merely that the form of basin is more elegant than any other, that it is more fit for particular houses than any other, and more convenient, and in what way it was so, one might see something in it, but it is not claimed as having any particular object in view."

After further comment his lordship said: "I feel it would be absurd to go on commenting upon this in detail. I could make a thousand objections to it. The more I look at it, the more satisfied I am that both the provisional and complete specifications are absolutely wanting in the essential features which ought to present themselves upon both provisional and complete specifications, and I therefore hold that it is bad for that reason. . . . It is not necessary to go further than to say the specification is bad to entitle the defendants to the verdict. I therefore give judgment for the defendants, with costs."

The last paragraph is a decidedly practical part of the learned judge's views, and one that may have its parallel in a really meritorious invention, presented as this one was.

The laws of all countries are sufficiently uniform to admit of certain fundamental rules in draughting patent specifications, and while nothing but technical knowledge of the constructive arts will enable one to properly prepare such specifications, there is no reason for writing them "out of form."

A specification should be directed to answering five questions, namely :

What branch of art does the invention "relate to?"

What does it "consist in?" that is, what are its main elements briefly stated?

What are its "objects" in use and practice?

How is it constructed?

What are the elements or functions added by the inventor?

These five divisions can be stated more briefly as: title, nature, objects, construction, and claims.

This seems simple enough, and is as nearly as possible what the law requires, but is widely varied from in many cases, much to an inventor's injury.

Lying before us while writing this, is a patent granted to an inventor in this City, that is no better and perhaps worse than the one that provoked Justice Hawkins' remarks. It indicates the additional vice of indifference to the inventor's interests, as well as the incompetency of the patent agents who prepared the specification. One "omnibus" combination claim includes a small socket, worth not more than five cents, not essential, and indeed not involving invention or anything added by the patentee, thus destroying completely the value of the single claim, which by reason of the state of the art will have to be confined to the particular combination set up.

The invention is really one of novelty and utility in high degree, but there is nothing, or nearly nothing, in the specification to show these facts, and the inventor's part is left out altogether.

This is a case prepared by one of the organized, routine bureaus, that take out patents by "contract," for so much apiece, and is worse than an inventor preparing his own case, which is bad enough.

Patent agents being sometimes skilled men with experience and knowledge of the constructive arts, disregard the ethics of the profession, and themselves apply for patents, but, as may be noticed, they never prepare and prosecute their own cases. They know too well the value of consultation, and how their own ideas and language are apt to be directed to a concrete instead of an abstract view of the invention. It is like a physician, who, when he becomes ill, at once calls in another physician to consult.

THE EVOLUTION OF STEAM ENGINES.

BY PROFESSOR JOHN E. SWEET.

We, as a rule, on finding anything written by John. E. Sweet, and not copyrighted, run a blue line around it and send it to the compositor. This is done with the assurance that the matter is intended for public use, and is publicly useful. Professor Sweet's quaint and critical methods of observation and analysis, coupled with a fearless candor, never fail to interest and instruct. The following is the main section of a paper of his, read in February before the American Society of Mechanical Engineers, at New York :

"In considering the present, let us review the past, and, trusting you will allow me, I will go back to the first step in the stairway of my interest in steam engineering, the Exhibition of the Royal Agricultural Society, at Battersey Park, in London, 1862, or 31 years before the Columbian Exhibition at Chicago.

I remembered that there was a lot of portable engines there, and so turned back to some printed letters written home at that time, and find this paragraph : 'But one still greater feature than all was the almost incredible number of portable steam engines, 83 different ones, all with steam up and going at the same time, and driving threshing machines, straw cutters, grist mills, tile and brick machines, etc. Six or seven were traction engines.'

To this I might add something about steam plowing, which was then and still is successfully practised in England, and the steam road rollers, which were common, but I do not call up this subject to show how we outstrip all other nations (in following in their footsteps), but to call attention to this branch of steam engineering (which has not been thus far considered), and to describe one of the many things I saw at Chicago which excited my liveliest admiration.

A traction engine of not the largest size, built somewhere in Ohio, well invented, not very well designed, frivolous in some of its details, and deplorable in workmanship, was harnessed to a 5-ton load of pig iron piled on a stone boat. The engine hauled that around over the dry ground with as much indifference as if it had been so many pigs of pork. It went down into the canal, wallowed around like a sea lion, and out up a bank where one would not expect to see a team draw up a wagon. It was driven up to a railroad track where the ties had been blocked up until the top of the rails were 2 feet above the level. The engine mounted this obstruction diagonally, first one forward wheel, then the other ; then alternately the back wheels in like manner, running along over the ties and turning off diagonally as it had mounted, in fact, performing the

feat precisely as an elephant would have done, and with like ease and indifference.

I was so astounded at this exhibition, so elated to see the justifiable pride shine out of the builder's countenance, that I did not stop to consider then, as I hesitate to question now, whether it would not have been better to build the engine with less of the spirit of a gymnast and more in line of durability in its legitimate work. Allowing the thing to be worth doing, the man who did it is never likely to receive half the credit he deserves. When the means are compared with the end, the builders of stationary engines and locomotives may take of their hats to the builders of traction engines, and call them brothers.

As the Cornish pumping engine set the pace in steam economy for half a century, so the Cardiff trial of portable engines twenty years ago set the mark so high that small engines of no kind have as yet in this country approached it. Compound portables have long been common in England, though they have not yet appeared here.

To go back to the same year 1862, the year of the second London Exhibition, my memory does not even picture the steam-engine exhibit, but I remember Mr. Porter exhibited a rapid-running engine, and patented, introduced and promoted the manufacture of the Richards indicator.

The next step on the Exhibition ladder was the Paris Exposition of 1867. At that exhibition two engines of mark beyond all others set their hands upon the industrial world, and have held them there for a generation, the Corliss engine from the parent works at Providence, and the Porter-Allen built by Whitworth. While the Porter-Allen was admired, and the maker's name demanded respect, it was too novel, untried, or for some reason did not take root in Europe. The Corliss engine, new to the Continent, was admired for its silver jacket, polished bonnets and general trousseau, ridiculed for its complexity, but understood by the leading engineers of Europe. Although Mr. Corliss had no Continental patents, it was taken up by three or four of the leading manufacturers, and royalties paid the same as if he had held patents, honorable deeds certainly, and if they have been reciprocated in like manner to the least extent the fact is not generally known. In plain English, if any American has paid a foreigner royalty on an unpatented invention, some of his friends should make it known.

While the natural sons of neither of these engines (the Corliss and the Porter-Allen) were shown at Chicago, what Chordal designated the Hyphen-Corliss, and what may be styled the Fitzporter engines, were too numerous to escape attention, in fact they constituted the bulk of that wonderful collection in Machinery Hall. It may be true, and likely is, that there were high-speed engines built before the Porter-Allen engine, but it is one that still lives, and I fancy one that has suffered least by changes and modifications, certainly least of any in looks, it is the respected parent of a numerous

group of sons and daughters-in-law that I shall speak of later.

Mounting the third step of our experience, the Centennial. While compound engines were quite common in Europe and on the sea, and Adamson had, I think, built his quadruple, none were shown at Philadelphia, in fact, our own engineers did not believe in them. Although the single cylinder engine has been transformed into many shapes it had then reached a pretty high state of completeness; the Buckeye, the only engine shown at both Chicago and Philadelphia, and the Corliss had reached the forms they followed for many years. The Corliss centerpiece, with its two single cylinders, walking beam and 30-foot gear, was one of the grandest steam-engine monuments in its impressiveness ever erected, but judged in the light of the present practice showed (as Mr. Porter pointed out at the time) just how not to do it. In explanation of this statement it may be well to give the substance of a friendly criticism of the great Corliss triumph, held under its own shadow. It was, as you all remember, a beam engine with two 40-inch cylinders, 10-foot stroke, two walking beams coupled to the two cranks of a shaft carrying a 30-foot gear working into a pinion some 12 feet in diameter, the engine making from 35 to 38 turns, and the second shaft about 90. By what process of reasoning our conclusions were arrived at I do not now remember, but it was agreed that two 40-inch cylinders at 4-foot stroke directly connected to the second shaft and run at the same piston speed would accomplish the result at an immensely less expense. The whole Chicago display shows that is what would now be done, and while Mr. Hemenway allows there has been a gain in pumping engines of only 20 to 25 per cent., I am sure the Allis Chicago engine will harvest 2 horse power from the sowing of the same amount of coal that it would take to get one from the Corliss Centennial, which, as it was specially suited to compounding, and yet was not compound, shows that Mr. Corliss at that time had not been convinced that there was enough advantage to go to that slight additional expense.

I am well aware that it is almost sacrilegious to criticise the design of that wonderful Centennial monument, but shall do so in the belief that the very audacity of the thing will emphasize the point I wish to make. The design was in two distinct styles intermingled, just the wrong thing to do as well in machinery as in building. The framing was of the most severe straight lines, almost seeming to be simply a reproduction in iron of its wood prototype, while the beams were in graceful curves, and the lever arms of the valve motions not curves but crooked and freely graceful. Milan Cathedral and the Corliss engine are noble examples of mixed architecture, but noble in spite of the mixture and not because of it.

When one sets himself the task of looking into this feature of machine design he will find in it one of the explanations of why things do not look right. There is an engine of recent production where the arms of the wheels are elliptical, a conspicuous lever I section, rocker arms round, cylinder head one style and steam-chest

covers another, and yet there seems no apparent reason why, if the machine was consistently designed, it would not accomplish the work just as well as it does now. I am well aware of the danger one encounters in criticising designs, and to simply say one looks well and another not, without giving the reason, is setting one man's opinion against another, but certainly there is such a thing as consistency, which plainly is subject to demonstration.

Builders of the modern improved Jones, Smith & Brown Corliss engines found themselves confronted by this condition. Steam pressure had gone from 60 to 120 pounds, and something had to be done to meet the new conditions. Three methods were open to them: put in more iron, put it in a better form, or make more attachments to the foundation. As is usual with improvers, the most of them take the wrong road. Hicks & Hargraves, of Bolton, England, adopted the right plan on the start by making the frame a complete box. The only Hyphen-Corliss engine exhibited at Paris in 1867 was of this make and this form. At Chicago two of the Corliss type claimed to be box section, but the builders spent some money to spoil them by cutting ornamental holes through their vital parts.

A round column (not more than 24 diameters in length) cannot be improved, except by putting more metal in it. In any other form it can be by making it round. A round tube is not a suitable form for an engine bed, a rectangular one is, and is nearly as strong as a round one. Aside from the push and pull the strain on a Corliss bed is a torsional one. A rectangular box will resist this strain about 16 times better than an I beam of the same cross section. Against a push and pull strain a crooked element is a weak one. If it must be crooked a box section is best able to resist it, but why crooked? There is plenty of room around a Corliss engine to make a bed straight and have it right, and when it is right it will look right, provided the designer has the ability and the observer the right training. This in no way means that everything should be straight, for as often, perhaps more often, the thing to be right has to be the furthest possible from that, and the one who makes the thing straight that should be crooked makes a worse blunder than the other.

As mentioned before, if there are two roads for an imitator to take to improve an original design he will take the wrong one; so, too, if there is any one feature that is bad or less meritorious than another, he is sure to stick to that with a persistency worthy of the best, and mutilate the subtle beauties he cannot appreciate, and this confirms me in the notion I have always entertained, that the overhanging cylinder of the Porter-Allen engine is not right.

Of the dozen or two of engine builders, both those who allow that their engine beds are of the Porter-Allen type, and those who build the same thing without the allowance, adhere persistently to the overhanging cylinder, and remodel the graceful contour of the bed (which has never been equalled) with a freedom wonderful to behold.

They not only hang to the overhanging cylinder, but hang on another one, in looking at which I can only think of an old man turning his back to the job, catching his boy and holding him out at arm's length, and the two working away, with the old man's posterior as the business end of the combination. Some of them, fearing the boy will get tired, put a crutch under his back.

In the most recent developments of the man and boy scheme, as it appears to me, the old man sits down on the foundation and takes the boy in his lap, each, however, true to his association holds to the overhanging cylinder.

I do not under-estimate the animosity I am likely to excite by criticising designs, and offer the following in justification, not in justification as to the right and wrong of my opinions, but in justification of doing the thing at all. We, all of us, talk about each other's plans, whether cross, compound, tandem, quarter cut-off, clearance, horizontal, upright, Corliss, Willans, Sulzer, triple expansion, or valve gear, and all the rest of it, without any feeling in the matter whatever, and steam engineering has been immensely benefited by it.

Artists, the most jealous of all people excepting musicians, criticise each other's work, and submit to the irrevocable decision of a hanging committee, and how are we to improve our designs better than to submit to the condemnation of our bad work by others, and applaud the good in others? It seems as if the question of whether cabinet work is an appropriate adjunct to a steam engine or not could have but one answer, and still it goes on, and I really suppose it looks nice to most people when new, and horrid to everybody ever after.

It would seem, after the example set by the Reynolds-Corliss, the Buckeye, and the German engines at Chicago, that we would soon see the last of it, and this leads me to the final step, the Columbian Exposition.

Through the kindness of the various builders I have been able to get a pretty accurate statement of the number, size, kind and power of the various engines of about from 100 horse power and upward. The list does not comprise the small engines, of which, perhaps, there was 150 horse power all told, nor does it include pumping, air compressing, gas engines, portable or semi-portable, of which no guess even has been made.

There were 29 single-cylinder engines aggregating 4,820 horse power, 47 compound engines aggregating 24,930 horse power, 5 triple-expansion engines aggregating 3,925 horse power, and one quadruple engine of 3,000 horse power, making in all 82 engines of a total of 36,675 horse power, exceeding the *Campania* by 7,000 horse power, making it likely the greatest aggregation of steam power ever assembled in so small a space.

Comparing the work of the present with that of 17 years ago, the Centennial with the Columbian, Chicago with Philadelphia, so far as the use of the steam engine is considered, it is a change from

single cylinder to compound, triple and quadruple expansion, and the generation and development of the single balance valve, shaft governor, high-speed engine. But so far as the production of steam from the combustion of coal, the best of to-day is but little better, if any, than the best of 1876, nor is the average to any great extent better than then. Boilers have been improved, so that higher pressures are as safe today as the lower pressures were before, and as more power is obtainable from high pressures than from low, to this extent has the modern boiler contributed its share to the improved economy. Water-tube boilers were wholly employed at Chicago, but that is no gauge as to what is the practice of the country, and only indicates the tendency which points as much toward higher pressures as it does toward the water-tube varieties, and the water-tube is gaining because of its ability to carry the high pressures.

An incredible amount of work has been expended on boiler and engine-room auxiliaries, some of unquestionable and much of questionable merit. Nothing has come to supersede the Worthington duplex steam pump, as its many copies confirm, wasteful as it is said to be in steam economy, and the various forms of steam injectors are mostly modifications of the original, and they hold about the same relation to the steam pump as they have for years. There are many new and many modifications of both single-acting and duplex pumps, and many modifications of the injector, mostly double, using the principle of the inspirator, but the main improvements have been in the simplifying of the number of handles to be operated, and in the devices that make the injector self starting. Economy in the use of steam, either in the steam pump or injector, does not appear to have made much headway. At least the more economical have not swept the old aside to such an extent as the automatic engine has superseded the slide-valve throttling sort.

Boiler feed heaters have taken on new forms, with likely constructive and possibly with operative advantages, but with little strikingly new in principle otherwise than where heaters and filters are so combined as to better rid the feed water of its impurities before entering the boilers. Treating the water with chemicals and filtering is probably the most recent and advanced change that has been made.

Various new boiler compounds have been compounded, but what advance, if any, has been made is in a wider understanding that the remedy must fit the disease. Just so far as compounds or filters prevent incrustation, or contribute to keeping the boilers clean, just so much they have contributed to economy, and if all fixtures are credited with the saving claimed, they far more than make up for the increased boiler efficiency, so that boiler makers may be falling back rather than progressing in the economy of steam production, though that is not likely.

Automatic damper regulators, high and low-water alarms, sediment pans, automatic boiler feeders, improved grate bars, mechanical stokers, various steam and oil separators, and the steam loop

have been studied over, changed, improved, perfected, or invented and applied during recent years, and these, too, in their way have contributed to steam economy, but in none has the change been more marked or results so advantageous as in the engines themselves.

Considering the engine exhibits at Chicago in the order of their magnitude, the 7,700 horse power of Westinghouse, Church, Kerr & Co. was so far beyond anything ever before shown by one exhibitor as to set aside comparison. Their standard and compound engines, which have been on the market for a decade, call for no comment except that inspired by the wonderful growth of the industry. To install an experimental engine at an exhibition is a very risky thing to do, to install six experimental 1,000 horse power engines of entirely new design, embracing untried mechanical devices, was a courageous one, and one that entitles the Company to as liberal consideration as the result requires to make the account stand on the creditable side. The new feature of an air spring to balance the weight of valve mechanism, and at the same time to serve as a starting bar, was as good a scheme as the many other good schemes shown by other makers.

The 3,000 quadruple Allis was too large for my comprehension, and I only raise the question whether the addition of the new feature to prolong the cut-off, and thus increase the range of power, is the best way to accomplish the result.

The Willans experiments tend to show, so far as an experiment with his style and that size engine can determine, that the superiority of automatic cut-off over throttling is less conspicuous on a compound than a single cylinder, and shows that there is very little or no economy at all in a triple expansion. If this applies to all multiple-cylinder engines, then it may be possible that it is the best plan to reduce the valve motion to the simple elements, and govern by a throttling governor. If this will hold good in the case of the Allis engine, of course the same points come up in the Buckeye, Fraser & Chalmers, and others, showing novel motions whose aim is in the same direction.

There is more or less tendency to mix the shaft governor and Corliss valve, as shown by three or four different examples, the aim being to retain the good points of the Corliss valve and be able to run at higher speed. A promising scheme.

One word about the Bates drop motion. If it is as good as the detachable arrangement then they can pride themselves on having something of their own, and while it does not place them above the first step on the Corliss monument, it puts them one step above those who only follow the original. I cannot follow out the list, noting every improvement each engine builder claimed, many good, perhaps one as good as another, and all worthy of a more extended notice than I am able to give them.

Among the marked novelties in engines, I mean a complete engine, that by Dr. Laval, of Sweden, was one of the most conspicu-

ous. Being myself the grand-nephew of a rotary engine, and this being a rotary engine, I speak as a relative, and venture to predict that, notwithstanding the 10,000 American patented rotary engines, this little Swedish bumble bee of a thing is nearer seeing the daylight of success than any other before exhibited. While it employs the principle of a Pelton water wheel it possesses just those additional elements not in the Pelton wheel that make it a promising advance.

The Willans engine, while nearly as old as many well-known American engines, is new to us, and remarkable in many respects, but particularly for its economy in spite of what we have supposed to be detrimental features, throttling, single acting, mechanically fitted valves, and high speed. But these defects, whether imaginary or real, are overcome or neutralized, and other advantages come in naturally, so that while at first sight the claims for its economy are questioned, there is a lot of genuine steam engineering in it. Besides the low clearance, free escape for water, and no loss from compression, the main thing lies, I believe, in the fact that the steam end of neither cylinder is ever in communication with the one of lower pressure or with the condenser. I spoke of the enormous growth of the Westinghouse, that of the Willans has been phenomenal, 20,000 horse power last year. We are prone to joke over the slow, conservative English, but perhaps they know a good thing when they see it, after all.

For great power in small space, the claim we make for our high-speed engines, it seems to me about an even send off between the Westinghouse, Willans, and that crowning feature of the engine display, the triple expansion 1,200 horse power in the German exhibit. Personally I have not much to say about this engine, though I went by it several times a day for three months. It was never my good fortune to be there when they were making repairs, and so I could see no more than other visitors. Another engine of like power, and occupying much more space and far more pretentious, seemed to be in a chronic state of repair mostly.

Of all that was said at the previous meeting, nothing pleased me more than Mr. Holloway's remarks about the Creusot engine. It was not only by far the best piece of machine work I ever saw, but up to the present time I believe it would be utterly impossible to produce the like in this country, and for the same reason that we could not produce work like the 'Venus de Medici' or Raphael's 'Transfiguration.'

As shown by the exhibits at Chicago, the standing appears in this way: The largest and most economical, and probably, as economical as has been thus far built, was the Allis engine, the largest exhibit by any one firm was that or the Westinghouse, both American; the most economical high-speed engine the Willans, English; the best piece of steam engineering, the German; the best rotary, Sweden; and the best workmanship, French.

As to the future, I think we may look forward to using better judgment as to putting the right engine in the right place. There is

a right and wrong place, if not for all, at least for several kinds. The claims against the high speed are that it is not economical, and terribly prone to smash-ups, claims pretty well founded, but, in spite of that, it has built itself up, and was the means of building up the largest half of the electric-light business. As to its wasteful use of steam, that has been overestimated, and is fast being improved; and as to the smash-ups, better separators and safety devices, and the destructive fly-wheel accidents of the last two years of slow-speed engines, put the boot on the other foot. With the high-speed engine and Mr. Porter came better work, and much better yet is needed, and will be demanded, for there is a place for the high-speed simple engine that nothing else can fill. There is, too, a place for the Corliss engine, and a place for the compound, though already many of them have been put in the wrong place; there is a place, and as yet a good deal of unoccupied space for a vertical direct-connected machine, and places for the triple and quadruple expansion. There is a show for better designs, a show for better workmanship, especially in castings; and as to the show for improvement in steam engineering, I can only reply, as Barnum did when asked what he thought his chances were for heaven. He said, 'He thought he had the greatest show on earth.'"

THE LAWS OF FRICTION.*

BY R. JAMES ABERNATHEY.

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"This seems to be an age of errors in relation to friction, as many scholarly mechanics appear to no longer comprehend the true meaning of the natural laws controlling friction, although seemingly very simple when understood. The fault is no doubt in a large measure due to the old masters whose text books are still relied upon by the masses. It is not that the old teachers were wrong in the enunciation of general principles, but were faulty in detail. They rested their laws on the success of general results, obtained during the experimental era, leaving coming generations to work out the details for themselves; but that very many fail to do and accept general results as covering the whole ground, something the masters of old would not have dared to do themselves. As an example we will take the general statement that friction is independent of surface, time or velocity. The statement is true when properly interpreted, and just as untrue when an improper construction is put upon it. Properly interpreted, it means that other things

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being equal, friction is neither increased nor decreased by increase or decrease of surface. Other things being equal, time has no influence, either way, on the coefficient of friction, it remaining constantly the same. Other things being equal, velocity, which is another way of expressing time, has no influence, either way, upon the coefficients of friction. To illustrate the first idea, we may take a square block of wood, iron or any other kind of material that may be desired, put a perfectly smooth face on it that will closely fit another smooth surface, and slide it back and forth a given number of times in a given period of time, and the frictional resistance is established. If the sliding block, or its sliding surface is doubled in size and exactly the same motion is given it, there will be no increase in frictional resistance provided, of course, there has been no increase in the weight of the moving block. If we increase the sliding surface four times in size without increasing weight, the frictional resistance in the aggregate will still be the same with the same motion. Viewed from that standpoint alone there is, nor can be, no increase of frictional resistance by increase of surface so long as the conditions of the surfaces remain the same. But if, instead of moving the sliding surface at the given rate, the velocity be doubled, we add a new factor which, while it does not change or increase the coefficient or original unit of resistance, it multiplies it by two which gives an aggregate of resistance twice as great; and right there is the stumbling block over which many fall. They take the general statement as it stands and arrive at the conclusion that, no matter how much surface or velocity may be increased, friction or frictional resistance in the aggregate remains the same, while it is the coefficient only that remains unchanged. Coefficients may be multiplied infinitely, and so it was understood by the old masters, and by them it was probably never dreamed that any other construction would be put upon this general declaration. The false construction placed upon the laws of friction is unfortunate in that it effectually misleads young learners who are striving to become masters of mechanics and mechanical law of all kinds.

While smooth, flat surfaces very clearly indicate the workings of friction laws in a general way, and answer well for experimental purposes, it is still important to carry the knowledge thus obtained beyond the experimental stage into the more active fields of practical mechanics in order to make the information of real value to the every day mechanic. What the embryo mechanical engineer requires is to know how the laws of friction affect running

machinery. The effect is about the same in a general sense, but varies some in detail ; the most notable difference being in the operation of circular convex and concave surfaces when in sliding contact with each other ; as, for instance, when brakes are applied to wheels, belts to pulleys and the like. For reasons so far unknown to the scientific and mechanical world, or at least so far unexplained, we here discover a condition that actually nullifies said laws. We find that by increasing the length of a common brake-block on a wagon-wheel, we at the same time increase its holding power, for whereas the wheel might have stopped with a short block a longer one holds it very firmly and that too without adding any additional weight. The same is true in reference to belts, which are perhaps better understood by the average mechanic than are wheel-brakes. If a belt slips and refuses to do its work, its stubbornness can be speedily and effectually cured by increasing its lap around the pulley. In both of these cases frictional resistance is increased by simply increasing the contact surfaces without adding anything to the weight or tension. This is a rather startling violation of natural law that was probably entirely overlooked by those who, many years ago, discovered and divulged the laws of friction. But, as said, while we now know the fact we are unable to explain the cause.

Turning aside from the discordant feature of the business, we will strike a more harmonious chord in looking upon the operations of a common shaft. The practice is to hang a shaft in a number (two or more) of journal boxes a few inches in length, that being done for convenience and to leave the main portion of the shaft freed for the reception of pulleys, etc. So far, however, as friction is concerned it would not matter whether the shaft were suspended in two or more bearings or encased its entire length in a journal-box provided the shaft was perfectly finished from end to end and the bearing surface perfect also. Here again do we have the theory of friction being independent of surface truthfully illustrated. A shaft twelve feet in length will run as freely in a journal-box twelve feet long as it will in three short ones of six or eight inches in length, all the work being perfect. But now we take two shafts of a given length, one a solid two-inch shaft and the other a hollow four-inch shaft, both having exactly the same weight, and we find, by revolving both an equal number of revolutions, that the frictional resistance of the four-inch shaft is just twice that of the two-inch, while yet the weight of both is the same. Here again we have unimpeachable evidence that friction is not independ-

ent of surface and velocity when measured in the aggregate, although the units or coefficients remain the same. It thus becomes quite plain that to understand the operations of the laws of friction, we must be able to distinguish the difference between units or coefficients and aggregate resistance when units are multiplied."

THE MULTIPLE-CURRENT SYSTEM.

(Reprinted from *Industries and Iron.*)

"The multiple-current system has two important features — the ability to be transformed, and to work motors. The ordinary alternating system transformed, but gave trouble as regards motors; the direct system worked motors, but did not transform easily. The multiple-current motor and the multiple-current system of distribution which sprang from it have been confused together; but it might be possible to run multiple-current motors from a low-pressure system, whose power was transmitted by another system and transformed. Again it is possible to use a multiple-current system of distribution without the multiple current motor. The invention we have in mind comes under the last head.

In September 1886, Mr. Wynne applied for a patent for what we believe was the first multiple-current system. He used a separately excited, or self-exciting generator, giving a multiple-current, and evidently had the Brush machine in view. Imagine a Brush machine with slip-rings, and one has a multiple-current machine with four or six circuits. These may be of high pressure. They were led to distant points, and there transformed down to low pressure. Here the currents were led to a commutator driven by a little synchronous motor run from one of the circuits. A low-pressure direct current was thus produced at the distant point. By this means all the advantages of the high-pressure alternating current were gained, as far as small conductors and ease of transformation are concerned; and all the advantages of low-pressure direct-current supply as to motors, arc lamps, and, if advisable, batteries were obtained. Such a system as this, we believe, more to the purpose in most cases than the employment of multiple-current motors.

When the direct-current low-pressure system is suitable to the locality, the Wynne system is clearly much superior to its later rival, as, other things being equal, a direct current motor is itself more convenient than a multiple-current alternating, and the troubles and complications due to the triple-current system are avoided. Even where motors are the main source of revenue this holds good."

EARLY HISTORY OF WOOD-WORKING MACHINES.

A portion of the historical matter contained in the *Construction and Operation of Wood Working Machines*, prepared by the editor of this Journal in 1870, having recently been several times quoted without even acknowledgment of its source, it has been decided to reprint the matter here, or so much of it as may have an interest to our readers. It will be proper to say that a good many of the facts presented are derived from a memoir of Sir Samuel Bentham, prepared by his wife, a very rare book, of which a copy was presented to the author by George Bentham, Esq., director of the Kew Botanical Gardens, London, son of Sir Samuel Bentham.

“As Bentham’s inventions constitute nearly all that was known of wood-cutting machines in the eighteenth century, their history at that period cannot be much else than an account of his labors and inventions, which we are sorry to say, comes down to us only through his patents and scraps of history gathered from the record of the English dockyards, where his machines were first applied to public use.

Brigadier-General Samuel Bentham, Inspector-General of the naval works of England, received a thorough classical, and it is presumed, scientific education, at the Westminster School of London, which no doubt ranked high as an institution of learning at that time (1770). After completing his education, his predilection for naval affairs led to his being bound to the master-shipwright of Woolwich Dockyard, where he served the regular apprenticeship of seven years, becoming familiar with all kinds of practical manipulation in wood and metal, and receiving the best scientific instruction that could then be obtained. After completing the term of his apprenticeship at Woolwich, he spent some eighteen months in visiting other dockyards, to familiarize himself with peculiarities of their tools and work not known at Woolwich.

In 1779 Bentham was directed by the Government to make a tour in the north of Europe to examine the progress of ship-building and other arts. During this tour, while in Russia, he invented the first *planing machine* for wood, at least the first that could be called an organized operating machine. There is no doubt but that this was the original conception of a machine for smoothing the

surface and giving dimensions to wood. It is to be regretted that no accurate description of the invention, so far as perfected at that date, has been preserved. Whether it operated by what, in his subsequent patents, he terms "rotative" motion, or whether it was a reciprocating machine, is, so far as the author can learn, left to conjecture. It would, however, be inferred from his first patent in England, of 1791, that it worked upon the later principle, for "planing and making mouldings" by some means that bore a close analogy to the hand operations of the times. He communicated his invention to the British Ambassador at St. Petersburg, who advised him to keep his invention for England, which seems to have been done, as there is no account of his having made any public use of it while in Russia. He afterwards accepted a military commission in Russia, with the rank of Lieutenant-Colonel, and became the manager, or commandant, of extensive factories for the production of glass, metals, cordage, works in wood, etc. His very successful management of these works would, from accounts, lead us to suppose that he invented many new and useful machines; but of these there seems (in England) to be no record. He returned to England in 1791, about which time his brother, Jeremy Bentham, the celebrated writer on political economy, had received from the Government an appointment to introduce industrial prisons in England. This kind of labor being almost devoid of skill, the talents of his brother were called into use to devise machines that would make the labor more profitable, and at the same time replace, to some extent, the want of skill of the convicts. To construct these machines, most of which were for working wood, the residence of Jeremy Bentham at Queen's Square Place, Westminster (now a part of London), was, with its capacious outhouses, converted into the *first manufactory* of wood-cutting machines. 103 years ago this factory was established, and, as we are informed, was not found to be sufficiently large, and a building, No. 19, York Street, was also occupied, which would lead us to suppose that a great many machines were made, and that the extent of the business fully entitles it to the distinction of being called the first general factory of such machines. Professor Willis, in a lecture before the Society of Arts in 1852, states that 'there were constructed machines for all general operations in wood-work, including planing, moulding, rebating, grooving, mortising and sawing, both in coarse and fine work, in curved, winding, and transverse directions, shaping wood in complicated forms, and that further, as an example, that all

parts of a highly-finished window-sash were prepared, also all the parts of an ornamental carriage-wheel were made, so that *nothing remained to be done by hand but to put the component parts together.* These machines were examined by members of His Majesty's Administration, and received official notice and commendation in the House of Commons in 1794. Sir Samuel Bentham was next commissioned to visit different dockyards, and to determine how far his machines could be applied to facilitate ship-building. At this time he refused a flattering offer from the Emperor of Russia, in order to accept this commission, choosing rather to give his country the benefit of his services than to reap a greater pecuniary reward that awaited him in Russia.

His report was no doubt very favorable as to the employment of machines, but it was not until 1797 that the Admiralty consented to their introduction. It should have been mentioned that during the time of his manufacture of machines at Westminster and York Street, patents were taken out describing all the different operations performed. After the Admiralty decided to adopt his machines in 1797, they were manufactured under the direction of Jeremy Bentham, and forwarded from time to time to Portsmouth and Plymouth, where they performed, so far as any record shows, all that was claimed for them.

The bills specify lathes, saws, machines for cutting, tenons for boring, also for boring bits and squaring tools, 'and many other machines for different kinds of work.' Machines were also devised by Bentham to facilitate block making, an operation that is yet classed among the most difficult. His machines, however, for this purpose did not seem to be perfect, for in 1810 he was joined by Brunel who had invented a machine for "shaping block shells." Brunel was at that time employed under Bentham to assist in the various operations, and to perfect his own machine, which must have had the endorsement of Bentham. In 1803, Sir Samuel, as Inspector-General, advised the Admiralty to adopt many additional machines that had already been approved, and to permit the erection of steam-engines to drive them, and they were accordingly ordered. The several dockyards were fitted with engines for sawing, planing, boring, tenoning, mortising, etc., and apart from better construction and the greater experience in their use, it is fair to infer they had nearly all the functions found in modern machines for these purposes. Their labor-saving capacity is sufficiently attested by the fact that Brunel, who had perfected and assisted in their con-

struction and operation, was rewarded by being allowed, as a premium for his inventions, the estimated savings of one year's work over hand labor in the dockyards, which amounted, as we are informed, to the very large sum of 16,000 pounds sterling.

In 1813 arbitrators were appointed on the part of the Government to settle with Jeremy Bentham, who, after the examination of numerous witnesses, allowed him the sum of £20,000 for machines furnished to the dockyards and penitentiaries. From the testimony given before this commission we learn that 'Sir Samuel Bentham prepared a system of machinery for the employment of men without skill. In 1793 patents were taken out on these inventions. The testimony states that no skill was required in the use of these machines; they were introduced into the dockyards and worked by common laborers.' The use of the machine saved *nine tenths* of the labor. 'A table could be made at one half the expense by their use,' etc., which goes to show that the machines were at least effective.

The machines and appliances for working wood that were invented and practically applied by Sir Samuel Bentham previous to the year 1800 may be enumerated as follows:

Machine for planing and forming mouldings — Improved planing and moulding machine (rotary) — Wedging guard for circular saws — Segmental circular saw — Conical cutters for dovetail grooves — Undulating carriage, to form wave mouldings — Compound cutter heads to work two or more sides at once — The *slide rest* — Tubular boring implements (core boring) — Crown saws (or cylinder saws) — Reciprocating mortise machine — Rotary mortising machine — Radius arm for sawing segments — Tracer guide for sawing irregular forms — Bevel and curvilinear sawing — Machine for grinding saw-blades — Taper gauge for sawing — Grooving table — Vertical adjustment of saws in benches — **T** rebating machine — Sectional cutters — Pivoted table for mortise machines — Forked or double mortise chisels — Gauge lathe, with slide rest — Rotary cutter for forming screw threads on wooden screws — Double grooving saws — Rack feed for planing machines — With many other things."

AIR TRANSMISSION OF POWER.

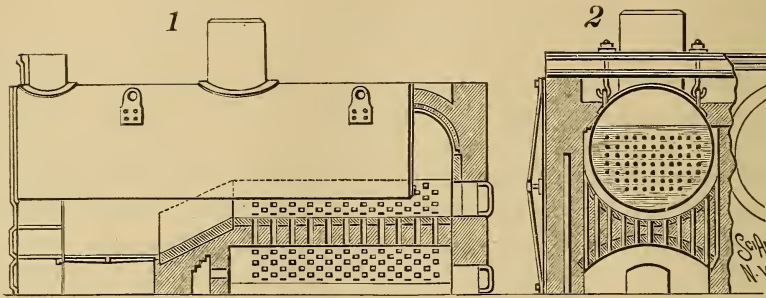
For twenty years past there has existed an opinion that in the transmission of power by compressed air there was a limit of efficiency of 40 to 50 per cent. This impression, or fact as it really was, became so firmly fixed in people's minds that the late improvements in this kind of transmission are not realized, and strangely has prevented much extension of the method in this country.

The fact is that under the latest improvements pneumatic transmission has become about as economical as any other, with some important advantages that especially commend it for small powers. Air being elastic the consumption is in proportion to the work, and not as the consumed volume, like water. There are no heat losses that compare with steam, no danger of fire, and, above all, an adaptation to existing engines arranged for steam. The high economy now attained is due to compression by stages, more efficient cooling during compression and reheating at the point of release or use, also improvements in the methods of compression by Riedler and others.

Our attention has been drawn to this subject by Mr. A. E. Chodzko, of this City, who as a graduate of the School of Mines at Paris, has naturally followed the development there of the extensive plants now in use, amounting to more than 5,000 horse power, also to the subject in general. He has also in a preliminary way considered the application of such a system in this City, and claims that the circumstances are peculiarly favorable for operating elevators and all small powers, including steam engines now in place.

Mr. Chodzko has recently made some researches in direct compression of air by steam without the intervention of shafts, flywheels or other equalizing apparatus, and claims that the steam and air pressures can be assimilated, thus simplifying and cheapening compressing machinery.

There was, many years ago, a franchise granted to a company in this City for distributing power by water, air or steam, but nothing has been done so far as known, not even plans made for such a system. The idea was, no doubt, to "issue bonds" first thing, at any rate there is no visible result, and the wonder is that the matter should drop when circumstances are so favorable. There can be no legal impediment to forming a new enterprise of the kind, which should be done.



THE ECKER AND LAIDLAW STEAM FURNACE.

Among the many new devices for securing more perfect combustion and saving fuel is that of the Ecker & Laidlaw Furnace Co., of Portland, Oregon, shown in the illustration above.

This method consists in constructing an annular floor or inverted arch, beneath and around the boiler about eight inches distant, as seen in the end view above, extending from the throat, or usual position of a bridge wall, to the rear end of the boiler, as shown in the side view or, as may be said, the bridge wall is extended back to the rear end of the boiler, and is perforated with a number of apertures, through which air is admitted from below to mingle with the gases of combustion.

There is in this, analogy to the methods of Mr. Chas. W. Williams, the author of a well-known volume on the "Combustion of Coal and the Consumption of Smoke," but in that case there was but a narrow or single line of air ducts across at the bridge wall, and, we may add, that no one has since added much to the general scheme of Williams' discoveries of thirty years ago.

The present seems an extension of his ideas and plans by continuing the effect of supplementing air supply until the act of combustion is wholly completed. The bed, or inverted arch, beneath the boiler becomes highly heated or "incandescent," as the inventors describe it, and the effect is, no doubt, that of completely consuming the carbon contained in the fuel. About thirty furnaces on this plan have been constructed in Portland alone, and Messrs. Parke & Lacy have taken an agency for this City and the Australian colonies.

COUNTERBALANCING.

There has recently been prepared an elaborate paper on counterbalancing locomotive driving wheels, that shows the enormous strains exerted vertically by these counterweights, and points to the conclusion that having ample abutment or resistance each way the effect of these balancing weights has not been realized, and, we may add, that no other subject so extensively connected with machinery is less understood. The mathematical "millinery" of the matter determines the extent and direction of the forces, but no more, and the practical part has to be left to experiment, or, as we may say, to resistances.

Suppose, for example, there is a vertical reciprocating weight operated by a crank, as in the case of a saw mill or a vertical steam engine, and a complete or equal counterpoise is placed on the crank wheel. This will act the same at all points of revolution, but the reciprocating weight acts only vertically, so the evil is not remedied but only changed, vibration will then be in a horizontal plane instead of in a vertical one, and the problem of expediency becomes one of foundations or supports.

If a vertical machine is set on masonry with a heavy foundation it is best to "absorb" the unbalanced strains in that direction, and dispense with a counterpoise altogether. If, on the contrary, a machine is set on or attached to a floor where there is great resistance horizontally, and but little vertically, then a complete counterpoise is best. Of course these conditions are reversed in the case of a horizontal reciprocating machine.

If the circumstances of erection are not known the best plan is to employ a weight equal to one half that of the reciprocating one, or, in other words, divide the evil, or its intensity, into two parts, each equal to one half of the whole. This is a rule derived from experience in operating with small reciprocating machines running at from 1,000 to 1,500 revolutions per minute, set in various ways and places.

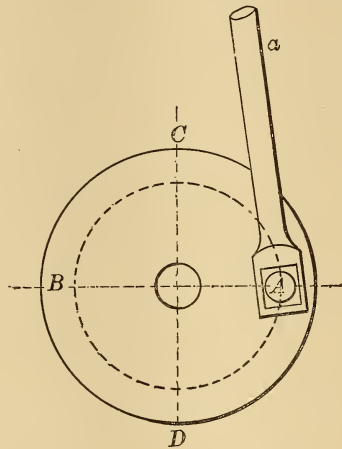
In a practical way it is useless to attempt balancing reciprocating weight with rotary weight. The only way is to balance with like reciprocating weight moving coincidently in an opposite direction. This was demonstrated by John Ericsson, as we believe patented by him about twenty-five years ago in connection with the athwartship engines placed in the "monitors." His patent, as now remembered,

was for oppositely moving balance weights of equal weight and range, or variations of these, the component of which would equal the momentum of the reciprocating weight to be balanced.

The following extract from the *Manual of Machine Construction*, on Crank Balancing, will present the subject in a practical way, and may be repetition in a sense of what has preceeded, but will make it more plain.

“In the case of reciprocating parts operated by cranks, counterbalancing cannot be accomplished, as is sometimes supposed, by attaching rotating weights on wheels or cranks. Reciprocating weight can only be balanced by equal reciprocating weight moving coincidently in the opposite direction in the same plane.

It is common to apply counterbalances to the cranks of steam engines, saw mills, and other cases of the kind for convenience, so the machinery will stand in any position, and to avoid vibration in the plane of reciprocation. This counterbalances in one direction only, and merely changes vibration from one plane to another.



This can be understood by referring to the figure. If the connecting rod *a* and its attachments weigh 200 pounds, then 200 pounds weight applied at *B* will balance *A* in a vertical direction, but as *A* has but little weight in the other plane, from *A* to *B*, the counterweight at *B* would be unbalanced in that direction, and the vibration would only be transferred from *C, D* to *A, B*. The only difference would be that so much of the connecting rod *a* as has its center of gravity on the crank pin, or, in other words, so much as is rotary, would balance an equal part of a weight applied at *B*.

The subject, therefore, resolves itself into a problem of foundation attachments for the machinery and the direction in which vibration can be best resisted. The strains can be vertical or horizontal, or

may be equally divided between the two. In the case of earth foundations the strains should be vertical, for floors horizontal, and when the position and method of erection is not known, the best that can be done is to apply a 'half balance,' that is, a counterweight equal to one half the reciprocating weight less so much of the latter as is rotary, or has its center of gravity on the crank pin, the relation of the two weights being of course as their distance from the center.

The intricate calculations respecting counterbalances found in text books have but little value in practice, because they cannot include the various methods of erection and other circumstances that vary in each case."

ECONOMIC MATHEMATICS.

We have more than once assumed that the fundamental principles of political economy could never rest on a sound basis until mathematically resolved. The remark is true of all knowledge, indeed nothing can come under the head of exact knowledge that cannot be mathematically expressed and proven. This idea has some expansion in Palgrave's Dictionary of political economy, where the following can be found :

"When the elements of the theory of dimensions have been thoroughly grasped, it will be easy to apply it to economic questions, and it will be found an invaluable check in the more intricate problems of coördination and analysis. Thus, if the unit of value-in-use or utility be taken as fundamental, and regarded as having the dimension U , and if the commodity we are considering be taken as having the dimension Q , then DEGREE OF UTILITY (q. v.) of the commodity, being the rate at which satisfaction is secured per unit of *commodity* consumed, will have dimensions $U Q^{-1}$, and will be readily distinguished from rate of enjoyment accruing to the consumer per unit of *time*, with dimensions $U T^{-1}$. *Price* determined by *marginal* or final DEGREE OF UTILITY (q. v.) will have dimensions $U Q^{-1}$ or P , and *hire* being price per unit of time, will obviously have dimensions $P T^{-1}$, or $U Q^{-1} T^{-1}$."

This may sound a little queer for a first attempt, but is not to be sneered at, for the time may come when to dispute a law of trade mathematically demonstrated will be the same as to doubt the forty seventh problem of Euclid, or the laws of gravity acceleration.

We once proposed a mathematical treatment of the subject of wages paid for production, and read a brief paper on the subject, but found that such rule was not wanted, and that the main object was to avoid any exact understanding of this particular matter.

GLADSTONE.

Mr. Gladstone has resigned, and now it remains for the historian to call to mind the tremendous part he has played in British legislation for half a century past, and for some still later historian to trace the ultimate effects that his innovations and policy will produce in the Empire.

The causes of his resignation are variously stated, and we take the privilege of adding one more, which has not, so far as known, been included, in the same terms at least. He pressed reforms of various kinds up to that point where the hereditary chamber, the House of Lords, became a barrier that must be removed. He could do no more without attacking this august body, a part of the British Constitution, and his physical powers were, as he well knew, not enough for the task, so he laid down his arms at the threshold, so to speak.

One who has lived in England, and studied the institutions of the country, her wide policy and interests that compass the globe, can bear with some patience the slurs cast by the Tory element on this grand man. The present place of England in the world's history is by the Conservative or Tory party there set down to institutions and methods of the past, and this may be true, but the future will require something else.

The Tory idea got a set back a century ago when the Colonial policy of England was not only changed but reversed. Since then, by arduous labor of her wisest men, her trade and her people have been freed as fast as the altered circumstances of the world demanded. Under Beaconsfield the "jingo" element that wanted to "smash some one" came temporarily to the front and fired the British heart, especially in the baronial halls and music halls, but was suppressed by the better sense and wide commercial interests of the Empire.

Peace and reform are the beacon lights that the intelligence and moral power of England follow, and a retention of antiquated traditional methods beyond their time is the greatest danger that the country can incur. A chamber of hereditary legislations is out of harmony with the present age, and more in England than elsewhere. We have also a chamber of inequality in respect to representation, and otherwise, and may have a problem the same as Mr. Gladstone had to deal with, in the near future.

Criticism of Mr. Gladstone can never go beyond questioning his methods, and posterity will judge of these. His honesty, scholarship and broad conception of human government will stand out in contrast with those who labor for the present alone. He was a giant among statesmen, who built for the future, and, whatever his opponents have said or may say, the time will come when they will do him reverence.

CAPTAINS OF INDUSTRY.

Mr. W. G. Sumner, in the *Forum* for March, writes of "The Absurd Effort to Make the World Over," and from the standpoint that it is very well as it is, which is true perhaps in respect to the people whose position he defends. With the general argument we do not propose to deal, except as to a single point, one not less vulnerable than many more, but one that it becomes in a sense our province to criticise, namely, "the great Captains of Industry."

By this term he means men who have secured control over vast aggregations of property, and amassed large private fortunes therefrom. The following quotation will show the position assumed by the author :

"If it is said that there are some persons in our time who have become rapidly and in a great degree rich, it is true ; if it is said that large aggregations of wealth in the control of individuals is a social danger, it is not true.

The movement of the industrial organization which has just been described has brought out a great demand for men capable of managing great enterprises. Such men have been called "captains of industry." The analogy with military leaders suggested by this name is not misleading. The great leaders in the development of the industrial organization need those talents of executive and administrative skill, power to command, courage, and fortitude, which were formerly called for in military affairs and scarcely anywhere else. The industrial army is also as dependent on its captains as a military body is on its generals. One of the worst features of the existing system is that the employees have a constant risk in their employer. If he is not competent to manage the business with success, they suffer with him. Capital also is dependent on the skill of the captain of industry for the certainty and magnitude of its profits. Under these circumstances there has been a great demand for men having the requisite ability for this function. As the organization has advanced, with more impersonal bonds of coherence and wider scope of operations, the value of this functionary has rapidly

increased. The possession of the requisite ability is a natural monopoly. Consequently, all the conditions have concurred to give to those who possessed this monopoly excessive and constantly advancing rates of remuneration."

In the early part of Mr. Sumner's argument, he has a good deal to say concerning reasoning from or drawing conclusions from false premises, which is certainly a common fault in most social and economic conclusions, but there is another fault, equally prevalent, of not considering the "character" of evidence and dealing with it in the abstract.

In the above quotation there is the assumption that the captains of industry move on what may be called normal lines, and their accumulations, corporate and personal, are acquired by some superior faculty or powers of mind denied to other men. This proposition can be successfully disputed, because the men of vast accumulations are commonly unscrupulous as to methods, and their achievements the result of opportunity promoted by unequal laws and connected with acts that the greater share of people scorn. In evidence of this we have only to examine the reputation and social standing that these "captains" have attained among our best people, also to consider their moral and intellectual gifts aside from the money-getting faculty.

What are the schemes or powers brought into play but attempts to over-reach and injure? and what are these vast aggregations of organized industry but a crushing out of the weaker ones that represent a more orderly and better social state among the people?

Mr. Sumner says he has traveled a good deal in Germany lately, and thinks Mr. Vanderbilt could reorganize the railway system of that country, take out twenty-five millions of dollars for himself, and improve everything. We too have traveled some in Germany, and have reached just an opposite conclusion, that it would be much better for us to have many features of the German railway management installed here. This view is perhaps supported by as much knowledge of railway matters as Mr. Sumner possesses, and from a standpoint as unprejudiced. This part of the article is decidedly from a "provincial" point of view.

The article is well written, and is worthy of study as embracing about all that can be said in favor of centralization and the great aggregations of capital which this country is becoming famous for.

ENGLISH METAL-PLANING MACHINES.

Engineering, London, in a recent issue, describes a metal-planing machine, in which the feed and reversing gearing are independent, and says that "owing to this arrangement the machine can, by means of a handle, be stopped, started and reversed without moving the feed gearing at all. Thus, if any accident happens to the tool it is only necessary to move a lever to stop the machine, and there is no risk of putting in a cut accidentally."

This is quite a discovery. It has taken at least twenty-five years for machine-tool makers in England to find out that the feed and reversing gearing of a planing machine should not be connected. It is certainly that long ago when the system was abandoned in this country, and nearly that long since any maker has ventured to rig up a machine in any other manner. If an English planing machine is to be stopped the only way is to stop the countershaft, and wait for things to come to rest, and if the machine is reversed the feed acts at the same time. The feed is performed with an abrupt motion, a blow indeed, from the tappets on the table at the end of the rapid or back stroke, and not in an easy manner at the beginning of the back stroke as in all American machines of which we have any knowledge.

But this is not the only fault of English planing machines. It is the custom, almost without exception, to drive them with a single band that has to be shifted two widths to reverse the motion. This latter is done by means of wheel gearing driven at high speed, noisy and perishable for that reason. There can be no certainty of where the tool will stop at either end of the table's stroke, and if a Cotter key-way is to be planed, a slot an inch or so long has to be made for the tool to stop in.

The American method has long been to employ two bands, one for the forward or cutting speed, and one for the reverse or run-back motion, the bands running in different directions, and the relative speed provided for by pulleys of different size on the countershaft. Nothing can be more simple than this, it is concrete, common sense. There is half as much tooth gearing, and the bands are shifted only one half as far, that is, one width instead of two.

But this is not all. As English planing machines have but one driving band there is, of course, no knowledge or use of differential shifting apparatus for the bands that moves first one and then the

other. It is true the single band has to be shifted across the face of an idle pulley, otherwise it would be partially on the two driving pulleys at the same time, as it is sometimes, causing a "shriek" at each stroke that indicates a wear of the bands and a loss of power.

Another feature can be mentioned. The bands for driving English planing machines are about double the width of those employed this country, and move at one half the speed, a fault of much importance, because the facility with which a band can be shifted is as its width, and the time directly as its speed. The wide bands cause the inaccuracy of stopping the table at the ends of the stroke, and slovenly operation generally. The countershafts for American planing machines run at from 250 to 300 revolutions per minute, the bands moving from 1,500 to 2,000 feet per minute, so the shifting is easy and noiseless.

Considering the advances in general machine-tool making, and that the English are the great makers in this class of implements for most of the world, this matter of planing machines is an anomaly, and now that it has been discovered that the feed motion can, and should be, taken from the main gearing instead of from tappets on the table, we may naturally look for further improvements.

THE INTERCHANGEABLE SYSTEM.

It seems, from a paper read before the Engineering Congress, at Chicago, by Mr. W. F. Durfee, on the art of interchangeable construction, that this system, as applied to firearms, was invented in France. The reference to this matter is as follows :

"Thomas Jefferson, writing from Paris, to John Jay, under date May 30th, 1785, says: 'An improvement is made here in the construction of muskets, which it may be interesting to Congress to know, should they at any time propose to procure any.

It consists in the making of every part of them so exactly alike that what belongs to any one may be used for every other musket in the magazine.

The Government here has examined and approved the method, and is establishing a large manufactory for the purpose of putting it into execution.

As yet the inventor has only completed the lock of the musket on this plan, he will proceed immediately to have the barrel, stock, and other parts executed in the same way. Supposing it might be useful in the United States I went to the workman. He presented me the parts of fifty locks, taken to pieces, and arranged in com-

partments. I put several together myself, taking pieces at hazard as they came to hand, and they fitted in the most perfect manner. The advantage of this when arms are out of repair is evident. He effects it by tools of his own contrivance, which at the same time, abridge the work, so that he thinks that he shall be able to furnish the musket two livres cheaper than the common price. But it will be two or three years before he will be able to furnish any quantity. I mention it now as it may have an influence in the plan for furnishing our magazines with this arm.'

On the 24th of January, 1786, Mr. Jefferson writes a similar letter to the Governor of Virginia, in which he is even more emphatic in regard to the gun locks he has examined, saying that: 'I found them to fit interchangeably in the most perfect manner.'"

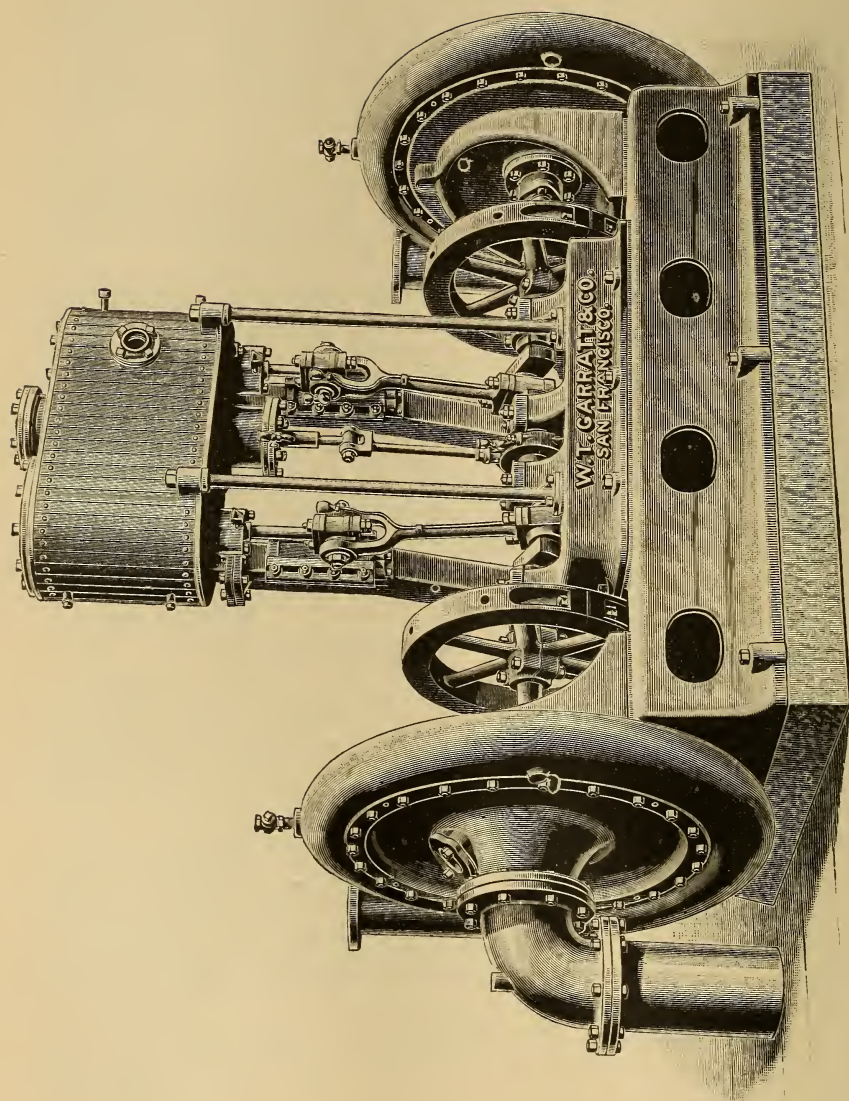
What was invented in France was really the "idea" or conception of a duplication of parts, which is a better name than interchangeable. It was reduced to practice it is true, but the important part of "how" to apply the system is of American origin.

In support of this proposition is the fact that to this day the method has made no progress to speak of in France, where even standard dimensions for machine parts are not a characteristic of their modern practice. There is not even a general system of screw threads, such as exists in this country and in England.

The great fact in the duplicate system is the methods of its attainment by means of automatic machines, in which the wear of cutting or grinding implements is eliminated or compensated. The system also includes gauging implements to determine dimensions, as in the Neilson Locomotive Works, at Glasgow, where there is said to be a gauging room maintained at a constant temperature, varied to suit various countries where the dimensions of certain parts are determined.

How nearly duplication has been attained in locomotive manufacture we do not know, but it has been a prominent feature in various manufactures in this country and in England. Tangye Bros., at Birmingham, in their "steam engine factory," as they call it, had ten years ago a complete system of duplication, and can assemble engines of standard types from the stores of finished parts.

The possibilities of the system depend upon the volume of product. To make one gun or one engine to gauged dimensions for all the parts would cost as much as to make a hundred, after the gauges and tools are prepared. Mr. Durfee could have added a good deal to the interest of his paper by describing the processes by which a duplicate system is installed, in gun or watch manufacture, for example.



COMPOUND DOUBLE PUMPING ENGINE.—W. T. GARRATT & CO., SAN FRANCISCO.

COMPOUND DOUBLE PUMPING ENGINES.

W. T. GARRATT & CO, SAN FRANCISCO.

The Edison Light and Power Company, of this City, about one year ago decided to bring water from the Bay to their stations for condensing purposes. A cemented conduit was made from the Townsend Street station to Mission Bay, nearly half a mile long, on a gravity grade, so the water would flow into a large sump formed in cement, and over which the pumps are stationed at Townsend Street.

A 24-inch cast-iron main pipe was then continued to the Stevenson Street station, nearly a mile distant, rising to create a resistance equal to 70 feet of head, or about 30 pounds per inch. To propel the water to the higher station, and also distribute in the lower station, the company contracted with Messrs. W. T. Garratt & Co., of this City, to furnish three pairs of centrifugal pumps driven by direct compound condensing engines, one of which is shown in the plate opposite.

The pumps are thus divided into three, or, as we may say, into six units to meet the varying requirements of the two stations where the power varies from 1000 to 5000 horse power during the twenty-four hours of each day, and are so connected by an elaborate arrangement of pipes and valves that the wide variations of power in the two stations, independently or in combination, can at any time be met by combinations of the pumps. These pumps are of 8 inches bore, with impellers 40 inches in diameter, perfectly balanced against side thrust, so the suction pipes can be connected at one side, thus giving a free water way and easy access to all parts. The engines are of a neat symmetrical design, as shown in the drawing, steam distribution being performed for both cylinders by a single piston valve of very ingenious construction.

Each pair of pumps, with the engines, are mounted on a massive sole plate, bedded in the floor of a cemented pit, large enough to contain four units, of which, as before said, three are now in place.

The problems involved called for a good deal of consideration. The large volume of water, and the head of 70 feet or more, the extreme variation in quantity, and the imperative constancy of supply, called for the subdivision in the pumping apparatus, before explained. The pumping plant, which we have examined, seems to have been carried out in a very complete manner by Messrs.

Garratt & Co., and the long-service pipes have caused no trouble this far.

The conduction of water from the Bay in long pipes is quite a problem here, such pipes form a congenial habitat for mussels that adhere to the iron, and build in a rough coating of shells that produces extreme frictional resistances to flow, and reduces the diameter of the pipes. It has been suggested that if the blow-off pipes from the boilers were connected to the rising main, and a great volume of hot water sent back, it might kill the shell fish, or cause them to let go. Whether this has been done or not we do not know.

A vacuum of 27 to 28 inches is obtained at the highest station, and if there are no unexpected expenses of maintenance the result will be a gain equal to or exceeding what was originally estimated. The maximum amount of water used exceeds 8000 gallons per minute.

RAILWAY MANIPULATION.

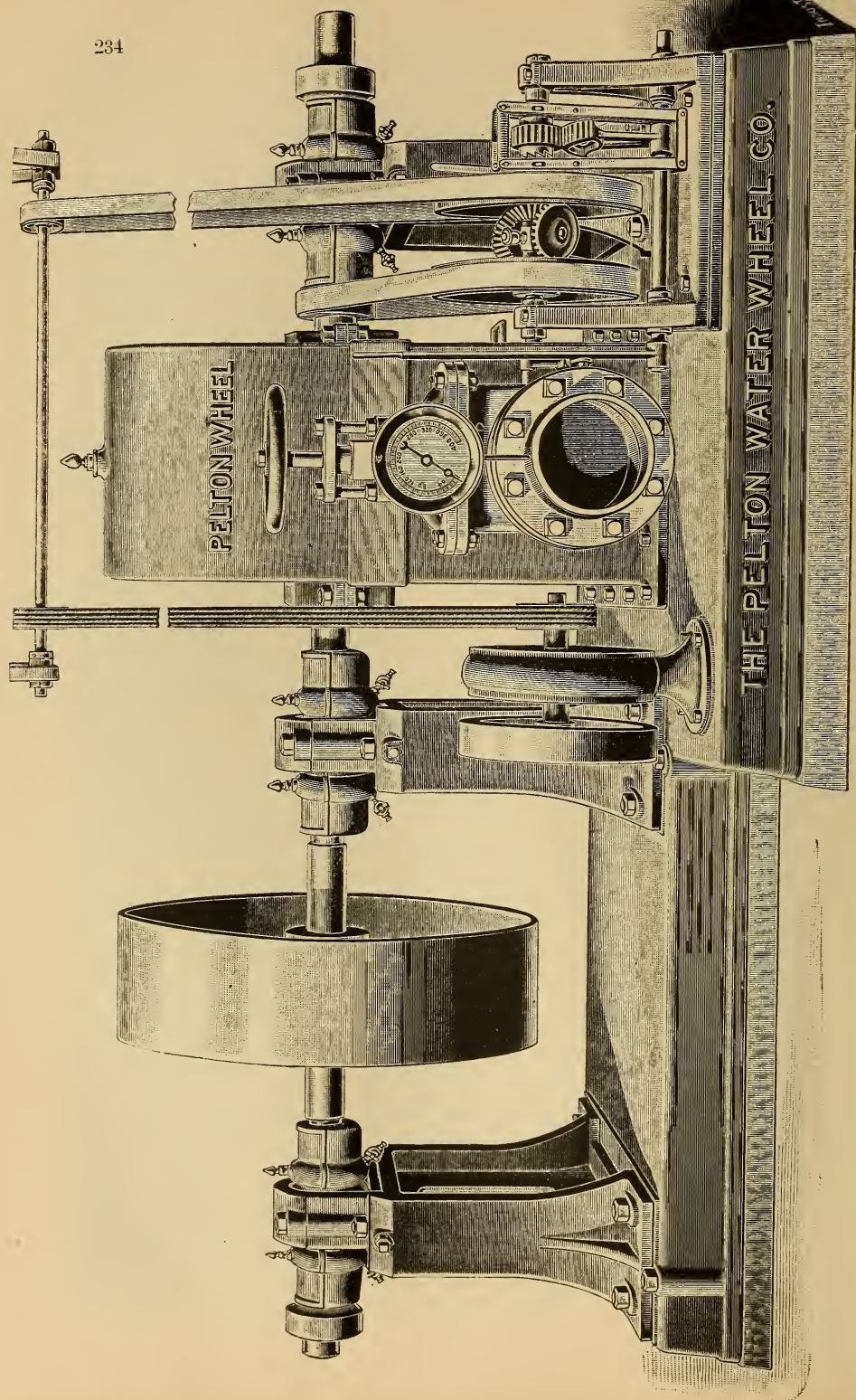
Mr. Labouchere, in the financial department of *Truth*, for Feb. 1st, has this to say in respect to the Southern Pacific Company :

"From the complete text of the revised lease of the Central Pacific Railroad Company to the Southern Pacific Company, dated December 7th, 1893, which has now been received on this side, it is evident that we have here to deal with a monstrous attempt at spoilation. Instead of the annual guaranteed rental of \$1,200,000 stipulated under the old lease of 1885, which was increased in 1887 to \$1,360,000 in consideration of the completion of a short length of road by the Central Pacific to connect with the Oregon and California, in the new lease, which the Directors of the Southern Pacific have in the most shameless manner negotiated with themselves as Directors of the Central Pacific (most of the Directors of the two Companies being the same) not only is the former company released from the obligation to keep up the property of the Central Pacific, but a fixed yearly rental of the nominal amount of \$10,000 per annum is substituted for the payment of \$1,360,000. There is, in fact, no probability of the Central Pacific stockholders receiving any dividends under this new arrangement. It may be as well to give the names of the men who have sanctioned this precious lease. The Directors of the Central Pacific are C. E. Bretherton (London), *C. F. Crocker, H. A. Cummings, *T. H. Hubbard, *C. P. Huntington, *H. E. Huntington, G. L. Lansing, C. G. Lathrop, and *A. N. Towne. The Directors whose names are marked with a star are also on the Board of the Southern Pacific, Mr. H. E. Huntington being President of the Central, Mr. C. P. Huntington, President of the Southern. It is a nice little family arrangement, which has thus enabled Mr. C. P. Huntington to trick the shareholders of the Central Pacific to the benefit of the Southern Pacific."

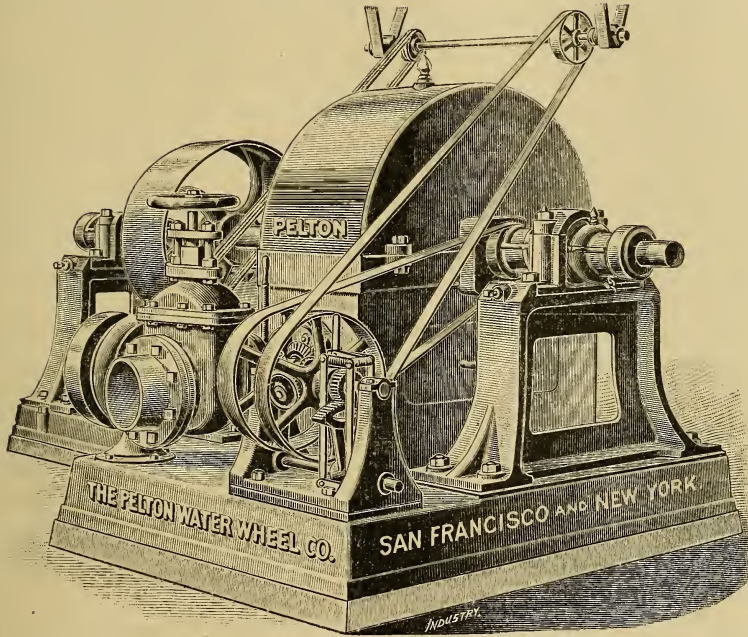
A NEW CHLORINATION PROCESS.

Industries and Iron publishes a description of a new process of chlorination invented by Mr. J. W. Sutton, of Brisbane, Australia, as follows :

"The chlorinator used in these trials consisted of a wrought-iron barrel lined with lead, through which passed axially a perforated tube lined with asbestos. Attached to this barrel was placed a smaller one, also lined with lead, and fitted with a steam jacket in such a manner that both barrels could be rotated by the same gearing at the rate of about five revolutions per minute. The damp ore is placed in the large barrel, and a charge of manganese dioxide, salt and sulphuric acid in the smaller one before commencing operations. In this way the ore as it is rotated in the larger barrel is saturated with chlorine as it issues from the central tube, and when the evolution of gas becomes slow the steam is turned on to the jacket, and thus ensures the complete decomposition of the salt. Valves in the barrels are opened at starting so as to allow of the exit of the enclosed air, and guarantee a strong chlorine gas acting on the ore. 'Three hours' treatment has been found sufficient for the dissolution of the gold in the Mount Morgan ores, and at the end of this time the contents of the barrel are run into a leaching machine, which is a centrifugal similar to that used for drying sugar. This method of leaching is found to be most economical of water, and seven minutes only are required for leaching a charge of 10 to 20 cwt. of ore. At the end of the leaching operation a small mechanical plow removes the spent ore from the centrifugal into trucks or into shoots leading to the waste tailing heap. The gold is recovered from the solution in a precipitating tank of rectangular shape, through which a spindle is driven from corner to corner. Kerosene oil and sulphate of iron are added to the leachings in this tank, and the precipitation of the gold is completed in ten minutes. A tap in the precipitator is then opened, when the water and base metals run through a sand filter, and the oil containing the gold in suspension passes into another small centrifugal, where the oil is immediately separated and ready for use over again, while the gold remains in the basket, from which it is scooped out and melted. Those of our readers acquainted with the Hall and Richards process, which hitherto has been in use at Mount Morgan, will see that the new process has many points of dissimilarity to it, and saves not only the bother attending the burning of the charcoal filters but also marks a great improvement in the methods of leaching adopted in older processes. In addition no amalgamation is necessary, as the gold separated from the oil is ready at once for the melting crucible, and the ore, unless it contains a large quantity of mundic, can be treated without any previous roasting, since the chlorine is delivered to the ore in an undiluted condition. The cost is stated to work out at 6s. per ton."



STANDARD WATER WHEEL, FROM 50 TO 500 H. P.—THE PELTON WATER WHEEL CO., SAN FRANCISCO.



STANDARD WATER WHEELS.

THE PELTON WATER WHEEL COMPANY, SAN FRANCISCO.

It is some time since we have published any drawings of water wheels by the Company above named, but the work of improvement and special modification has been going on. The diversity of use met with on this Coast calls for an endless amount of change, both of capacity and arrangement.

We have just examined a pair of reversing wheels of 100 horse power to operate a hoisting plant, arranged to work under a head of 850 feet, equal to pressure of 200 pounds to an inch. The wheels themselves, while large in diameter, seem otherwise a kind of unimportant detail when compared with a steam engine such as would be required for the same work. They are solid discs of steel with buckets of bronze.

The drawings herewith show late examples of water wheels arranged with differential governing apparatus, wherein the relative

speed of the main wheel and an auxiliary one controls the jets, and secures a sensitive regulation.

The auxiliary, or governing wheel, is seen at the left in both views. This, by means of the countershaft at the top, conveys motion to one of the pulleys on the right. The other pulley, as can be seen, is driven from the main water-wheel shaft. These two pulleys are connected by bevel wheels, so that when both the water wheels are moving at their normal rate the intermediate bevel wheels remain still, in respect to the supports or studs on which they are mounted, but the slightest change in the relative speed of the two driving pulleys, or of the two water wheels, revolves the shaft on which the former are mounted, acting on the regulating valve of the main wheel.

The small wheel being unloaded runs at a constant velocity, the main one following, or being held thereby, at the same relative speed. As will be seen, the Company have mounted the wheels on massive sole plates, to which all parts are bolted, and are thus maintained in line. A tangential wheel will operate under almost any circumstances, and in many cases it is expedient to erect them in the cheapest manner, but for permanent plants within reach of carrying facilities it is much better to construct and mount the wheels as shown in the drawings.

The Pelton Water Wheel has been presented for examination to the Committee on Arts and Sciences of the Franklin Institute, Philadelphia, with a view to receiving such award as the merits of the invention may warrant. The subject has been referred to a sub-committee, consisting of the following members of the Institute :

John Richards.....	San Francisco.
John C. Trautwine.....	Philadelphia.
John H. Cooper.....	"
M. Merriman.....	"
C. G. Darrach.....	"

The investigations made by this committee are crucial and exhaustive, usually consuming a great deal of time, and in case the invention considered is found to be meritorious and useful, the committee recommends the award of one of the medals or legacies entrusted by donors to the Institute to be dispensed in such cases.

The Company have been quite busy, and have greatly extended the field of their operations, also their designs, patterns and facilities, including various kinds of gearing for transmission.

LITERATURE.

The Inter-Oceanic Ship Canal by the American Isthmus.

We have received from the author, Mr. N. J. Manson, of this City, a copy of his late pamphlet on the above-named subject, containing a paper read before the Technical Society last year, in which the physical, historical, and economic features of an Isthmus canal are discussed. The pamphlet also contains an outline of the Frelinghuysen-Zavala Treaty of 1884, the Clayton-Bulwer Treaty of 1850, and a synopsis of the concession under which the present canal company are or have been operating, with other matter relevant to the subject.

We have published an essay of Mr. Manson's on the Nicaragua Canal problem, and several times excerpts from his writings on the same subject, in all of which he vigorously and earnestly recommends that the enterprise be carried out as a National work by the General Government.

We have also, as often as possible, endeavored to find out what objections or impediments exist to this course, and are free to say that all logical, not to mention legal reasons, seem to be on the side of Mr. Manson's views, and we recommend that any one interested in this matter, as all ought to be, should procure a copy of the present pamphlet and read it.

Mr. Manson's legal knowledge, coupled with a very clear conception of the physical and technical nature of this great work, has enabled him to set it forth in such a way as to thus far prevent the use of public money, to be controlled by a private corporation. We say this believing that his work has been the chief restraining cause of preventing in Congress the passage of a bill lending the Government's credit or its money for this purpose.

Of the Frelinghuysen-Zavala Treaty, which contemplated government construction and ownership of the Canal, Mr. Manson says:

"I have in my possession a copy of the treaty between our Government and Nicaragua, which was drawn by Messrs. Zavala

and Frelinghuysen. It is admirably drawn, and is very favorable for Nicaragua and for the United States. That treaty was drawn in the interest of the people. Mr. Frelinghuysen was a diplomat of the highest order. Nicaragua was ably represented by Joaquin Zavala, Minister Plenipotentiary and Ex-President of Nicaragua. Under the terms of that treaty the Government of the United States had full management of the canal while it was building. After it was constructed, its management, care and direction passed to a board of managers of six persons, three appointed by the United States and three appointed by Nicaragua, the President of the board was to be from the United States. In case of a tie, the President had the casting vote. You will see at once that any question of traffic could be solved in favor of that country whose commerce was most profoundly affected, and which was most deeply interested in the freedom of the Empire of the Sea.

Another favorable feature of that treaty was, that all United States vessels engaged strictly in the U. S. coastwise commerce could be favored and passed free of tolls. Mr. Zavala was equally watchful for the interests of Nicaragua, and her vessels engaged in her coastwise trade could be favored and passed free of tolls. Of course due regard to other nations would require that our ships bound to foreign ports pass through at the same rates as foreign ships.

Now, remember that Nicaragua sent its representative to the United States to sign and conclude that treaty, and it was signed and concluded in Washington on the 1st day of December, 1884, by the Ministers Plenipotentiary of the two Republics. Twenty-seven senators were in favor of its ratification and of Government construction and ownership of the canal. But a set of very shrewd, designing, and ambitious men, probably a commingling of Wall Street and London sharks, saw, or thought they saw, an opportunity to put that canal through in their own private individual interests, and the treaty was very unwisely and improvidently withdrawn from the further consideration of the Senate of the United States. It was a treaty virtually affecting the commerce of the United States, assuming the placing of that commerce upon a sound basis, and of paramount importance to our people."

Copies of this pamphlet can be obtained from Mr. Manson by addressing him at 1625 San Jose Avenue, Alameda, California.

LOCAL NOTES.

The Pacific Tool and Supply Company, of this City, have been extending their facilities and stock, and have become a kind of store for the works around them. It is not our intention or custom to deal with purely commercial affairs, but there are peculiar conditions of the supply system on this Coast that do not exist elsewhere. When we came to this Coast fourteen years ago and stumbled into a book store, the matter was amazing; the stock exceeded anything before seen. An inquiry was answered, by pointing out that the bookseller was 3,000 miles from the base of supplies. The same thing exists in machinery supplies. If each works had to keep in stock the stores such as are provided by the company above named, it would lock up in idleness, twenty times the capital required to accomplish the same end in the hands of the private firm or company. Not only this, the purveyors become agents of all the works in watching for improvements, guarding against deception, and buying at the lowest rates.

The Union Gas Engine Company, of this City, have issued a new edition of their catalogue with new and fine drawings of various types and adaptations of their engines, not previously time illustrated. There are testimonials from those who have the engines in use for every kind of duty, and at the end a partial list of those to whom engines have been sold, the aggregate sales being over sixteen hundred, which is a wonderful record for this Coast where the entire population is less than two millions of people. The first part of the catalogue contains some history of the rise and progress of the gasoline type of engines, which has been marvelous, and now has assumed a place, not as an adaptation but as a standard motor of the most simple construction and reliable action. No one now asks if a gas or gasoline engine will do a certain work, but what is the comparative cost of this and other systems of motive power. To this the answer is plain, about two cents per hour for each horse power, and a corresponding difference in the expense of attendance and risks of all kinds. The Union Gas Engine Company make a specialty of marine engines, and issue a catalogue devoted to that branch of their business. The present catalogue deals mainly with standard engines from one to twenty horse power, of increased proportions and new design.

Mr. E. A. Rix, of this City, the agent here, has sent some descriptive circulars of a peculiar manufacture showing how far classification is carried at this day. The business is that of making derricks and hoists with all kinds of complementary apparatus which is packed and shipped all over the country like hardware or any other staple commodity. The main business seems to be in making hoisting tackle for quarries, contractors and like work, embracing masts, derricks and booms of various kinds and arrangement such as are commonly improvised on the ground or specially constructed to order. A large number of photo-plates show how the strains of lifting are provided for at great heights in the air with light tackle, that seems out of proportion to the loads, but is not, when the material and proportion are in the right place. Ready-made houses seemed the end of a division of manufactures, but the product of the Hoist and Derrick Company at St. Paul, Minn., is more diversified than house manufacture even.

Messrs. Palmer & Rey, of this City, continue to send gas engines to the East, a car load at a time, which is a very remarkable circumstance accountable for in some measure, no doubt, by a systematized manufacture in their works, which are provided with good implements, in good light and abundant room. The Company have recently added fifty men to their working force, which is a hopeful sign for the present time, and we may add, an exceptional circumstance. The manufacture of printing machinery by this firm, successfully carried on for a dozen years past, is another exceptional circumstance, because in competition with makers at the East, with vast establishments, and an organization of labor that is unattainable here. With cheap iron and coal, or even these as cheap as they might be, there could grow up here various kinds of permanent manufactures, now almost impossible.

The Westinghouse Electric and Manufacturing Company, last month opened a branch office in this City, at the Mills Building, and from a notice received it seems that a complete stock of apparatus for electric equipments is to be kept here, ready for delivery. The future of electric development on this Coast is, no doubt, to be mainly in power transmission. Lighting is limited by population, and nothing can much extend this interest beyond its normal proportions, but power transmission is a matter of circumstances and

opportunity. We do not know of any statistics that give the proportion of motive apparatus to population, but suspect if there were such statistics, the Pacific Coast would come out ahead. Water raising alone requires a power outfit equal to the total found in most sections of the United States. The Westinghouse Company have, no doubt, in view transmitting apparatus mainly, in the establishment of a branch here. How far they have progressed in regulation, and other requirements of electric motors, we do not know.

The *Engineering Review*, containing a resumé of current progress the world over, and a methodical index to the technical literature of each month, has so improved the latter by arrangement and a judicious selection of type for headings, that there is little labor in going over the lists. The *Review* is edited by Mr. J. S. Jeans, and will be found a most valuable and time saving publication for active engineers who, as a rule, have no time to search through a score of technical journals each month. Its criticisms are fair, intelligent and just, and the wonder is how the compilation is done at the low price of sixpence for 36 pages of matter, equal to 72 of these.

Locomotive Engineering has published an "educational chart" of an American locomotive that is the most wonderful drawing we have seen. Every detail up to 240 parts are seen in the drawing, numbered and the name set in the margin. The interior parts are brought out by tinting, and the whole is shaded, making a beautiful picture as well as an instructive chart or diagram. Just how the work is done is hard to understand or describe. You see the drivers and side details in shaded elevation, and through these the parts behind, even to the grates and crown braces. The publishers propose this year to furnish three of these educational charts to be supplied with the journal, but finding a wide demand beyond their list, they have had a quantity struck off to be sold at 50 cents each, and will be the best investment of that amount an engineer can make.

COMMENTS.

Mr. M. M. Trumbull, in the *Open Court*, of Feb. 22, sets up an analogy between the British House of Lords and the United States Senate, and intimates that this latter body invites "abolishment,"

and such an issue is imminent in this country. It is an anomalous body founded on the pattern of the dynasty of the Georges in England, and with functions and constitution not republican or democratic whatever else they may be. The editor of the *Indianapolis News* says "it is the greatest log-rolling body of law makers in the world." We do not understand the meaning of "log-rolling," but if that signifies making merchandise of offices the claim has great color of truth. The executive functions of the Senate are anomalous, and when exercised as now, are something worse than that. At the present time the whole commercial and industrial interests of the country are being trifled with by the Senate.

Mr. Trumbull, in his critical notes in the *Open Court*, tells how a convention of dairymen met in Chicago urging legislation to enforce the "purity of dairy products," and "protect" people from the oleomargarine trade. About the same time the citizens of Omaha enacted an ordinance enforcing the "the purity of dairy products." In this case the citizens of Omaha did just what the dairymen wanted done in another city, but the Omaha law did not suit them at all; far from it. What they really wanted was competition shut off, so they could use more water in their milk and sell worse butter. The "protection" idea is the same the world over. It begins and ends, so far as aims, with the protected person or persons, and is to "smash the other feller." One exception is that of the steel-rail combination, which, by the account of some of its friends, is only to "apportion orders," so none of the makers would be left out, but was not to raise the price of rails. These things betoken a highly generous state of community, exemplifying the saying "let God be true though every man become a liar," or words to that effect.

There is a thoughtful and suggestive article in the *American Engineer and Railway Journal* on the "Elastic Limit of Audiences," that should be read and studied as widely as possible. It relates in brief to the absurdity, to use a harsh name, of introducing mathematical demonstrations into papers to be read before an audience of people, of whom not one tenth can follow the computations, and not one half of the tenth do so. The use of complex formula, or indeed almost any kind of formula, in a public paper is in bad taste, and generally pedantry pure and simple. Conclusions can be stated in words. The means by which conclusions are reached are implements

and not results. This "mathematical millinery," as some one has called it, is sadly out of place when paraded in public beyond a few fundamental points that can be intelligibly displayed in a manner to be generally comprehended. As a rule a mathematical presentation should be construed as indicating a poverty of resources. The manipulation of quantities is not at best a very difficult branch of technical knowledge, and does not interest an audience.

An exchange says that U. S Engineer Shunk, who made a survey for an international railway through Mexico and South America, and, of course, Central America, has completed his work, and reports that it will cost \$22,000,000 to build the road-bed and bridges. We think there has been a cipher dropped from the millions somewhere, and farther, that if a road-bed could be made at the price named it would be a good deal more than it was worth. A railway along a sea coast for many thousands of miles mainly to reach cities having deep-water harbors would be a commercial anomaly. Steamers moving on shorter lines could beat the trains in time to the eastern coast of South America, and also to the western coast if the Nicaragua Canal was done; can carry passengers in greater comfort, and at one half the price that a railway would demand. Freight could be carried at one third as much, and, as a competent engineer in these countries claimed last year, if such a railway was made and equipped no one would dare to accept it as a gift and be obliged to operate it.

The decisions of Judge Dundy in the case of the Union Pacific, and of Judge Jenkins in the case of the Northern Pacific Railway, have stirred up a good deal of comment. The procedure was, on both cases, an injunction restraining the men from striking against a reduction in their wages. This is done like some other things under the authority of receivership, which is becoming just the opposite of what was intended, that is, securing railways against their liabilities, and to coerce workmen. It is true other judges have dissented from any such ruling, even impeachment by Congress has been talked of, and has been the subject of a motion. Judge Caldwell, who was petitioned for a similar ruling, said that notices of a reduction of wages should be given to the workmen, and then if they wanted to quit the employ of the company it was their privilege, such changes he said should have mutual rules each

way, and this is both fairness and common sense. Of course no one will admit any right of men to interfere with others employed in their places, or with the railway companies' property, but the Dundy and Jenkins decisions went far beyond that. The result of such circumstances will be a populist administration before long.

The *Iron Age*, in a recent issue, has an editorial notice of how much better off mechanics are in Philadelphia than in other cities, because they can own their own homes, which a large share of them do, and says the main difference from New York is that there are constructed in Philadelphia a large number of small independent houses. This, so far as it goes, is true, but it is a very incomplete explanation. Philadelphia enjoys in effect the advantages of the single tax system, as recommended by Henry George. A mechanic when he wants a home does not have to pay as much or more for land as he does for a house. He leases the land perpetually, pays a ground rent, and enjoys a title just as good as one in fee simple. He can pay out the land value if he so desires, but this is not commonly done. Each family must have 15 feet square "open to the heavens," so tenement houses are impossible. The main wonder, which our contemporaries can study with advantage, is that while the real estate pays the taxes in Philadelphia, rents are only half as much as in New York.

An Act of Congress, recently passed, provides for the inspection and marking of boiler plates, and their stamping by the Government inspectors at the works where plates are made. This is certainly an important regulation, and one that will save a good deal of trouble for boiler makers. The quality is an element of manufacture, and is assumed and assured by the maker, and certainly the best and most convenient way is for the inspectors to examine and pass upon the work before it leaves the manufacturer's hands. If the plates pass out to merchants, and then to boiler makers, any fault of class or marking must follow back to the original makers in any case, or ought to, and certainly that is the proper place for inspection. There is a penalty of \$1,000 and imprisonment for fraudulent marking. The Act had its origin among the Pittsburgh manufacturers.

There seems to be a wonderful lack of information respecting the amount of work done on the Nicaragua Canal by the corporation now in charge of that project. As the surveys of Commander

Lull and A. G. Menocal were made by the U. S. Government over the present route, except an unimportant deviation on the Pacific side, the total capital stock of the present Canal Company must consist in the work accomplished and the expenses of promoting their enterprise. The long and short of the story seems to be, as Mr. N. J. Manson claims, that when the construction of the canal by the U. S. Government became imminent it was conceived to be a good scheme for a private company to wedge in between, and secure such control as would make it difficult for the Government to construct the canal without consenting to a "shave" in the interest of these private promoters. In the late report of the President of the Maritime Canal Co., Mr. Hiram Hitchcock, it appears \$1,014,500 has been paid in for 10,145 shares of stock sold. From other sources \$48,871 has been received, making a total of \$1,055,811. 180,000 shares of stock have been issued for concessionary rights, privileges, etc. This is estimated at \$18,000,000. The total of cash paid out for construction is \$830,788, also 31,900 of the full-paid shares valued at \$3,199,000. There is, however, no inventory or even estimate of what has been actually performed in the way of construction.

Steam boilers, as Mr. Carlyle would have said, are taking themselves to pieces, and resolving themselves into a sectional form. This is a sequence, or is rather an imperative requirement, of increased pressure, and the difficulties and dangers of large bodies of heated water and the enormous strains that fall on vessels of large diameter. The Bellville boilers, such as have been recently put into the Great Northern steamers at Cleveland, and in some Government vessels in England, have been tested on the last-named vessels at 337 pounds per inch, the guarantee being only 225 pounds. One cannot help thinking of the *Anthracite* that twelve years ago was an anomaly with pressure a little more than this, also will think of the Perkins experiments that began about thirty years ago, and thirty years before the world was ready for high steam pressures. Perkins was an English inventor who claimed that excessive pressure up to thirty atmospheres was economical and practicable.

Speaking of Perkins and his high pressures reminds us of a very remarkable circumstance connected with them. In oiling his cylinders at 800 or more degrees of temperature, the oil or tallow was distilled or decomposed into fat, acid, glycerine, stearine, etc., and

left a residuum, supposedly stearine, that puzzled the inventor, and he embodied some mention of the matter in his patent specification. This trivial circumstance came up afterwards in a very important matter. Messrs. B. C. & R. A. Tilghman, of Philadelphia, discovered and patented the process of distilling fatty matter by high pressure steam, an invention that soon spread over the world in connection with soap and candle making and the manufacture of stearine and glycerine. Suits for the infringement of these patents of Messrs. Tilghman were in the U. S. Courts about twenty-five years, and one of the main things relied upon to impeach the patents was the queer substance that Perkins discovered in his high-pressure steam cylinders.

In an article in the *Forum*, for February, we are treated to another vigorous flaunting of the British flag in the Nicaragua Canal matter, a method of appeal to American capital and Governmental support that will not be likely to succeed. There is little danger of the promoters taking their scheme abroad. It was not organized with any such idea, because any attempt to enlist support from Great Britain, or any other country, would be met with conditions that would not serve the intended purpose. If the Canal Company were to offer to the British, or any other government, such terms as have been proposed here, that of furnishing capital on "valuation," reserving the power of fixing rates, and providing for a majority of directors in the private or corporative interest, the scheme would meet with cool reception. To imagine the difference, suppose the British Government had the Central and Union Pacific Railways to deal with under the circumstances that exist here now, or at any time during ten years past. There is no danger of any foreign government taking over the canal matter on any terms that would not enable its quick construction by the United States.

The Franklin Institute, Philadelphia, has created a section of "Engineers and Naval Architects," which is timely in one sense and untimely in another sense. The Institute was founded to promote the mechanic arts, although science was, as we believe, afterwards added to the dedicatory title. The mechanic arts include science, or at least so much of it as is applied, and a closer attention to practical matters will, no doubt, render the work of the Institute more useful. By untimely above we mean that sections like the

present one should long ago have been founded and maintained. There has been a microscopic section, and a chemical section, and for some years an engineering section, and now the one above named. The order of sequence if inverted would come nearer conserving the objects of the Institute. We make these remarks under the impression that the Engineers' Club, of Philadelphia, a very important organization, should and might have been a section of the Franklin Institute.

The *Iron Age* grows righteously indignant over a suspicion that the railways are giving lower rates to some of the large iron companies in the Pittsburg district, and presents the enormity of such an offense in strong terms. We find no fault with this view, but will ask when the railways did not make concessions to those who ship large amounts of freight? That it is unfair and unjust goes without saying, but it is in the line of other things of the kind. A good many people are not too old to remember when the Government sold internal revenue stamps to the makers of matches, at a discount of ten or fifteen per cent. when the sum bought at one time was \$10,000 worth or more. The "drawback" system is a similar proceeding. Small firms, and some that are not small, do not ask for drawback allowances on goods sent abroad that contain imported material, but all large combined interests look after this matter with avidity. The Standard Oil Company, for example, collect on the tin in their packages, but no maker of tinware shipping small quantities of goods asks for a drawback.

Our able contemporary, the *American Engineer*, speaks in a disappointed vein respecting the dynamite gun on the *Nichteroy*, formerly the *El Cid*, that was fitted up and went to Brazil to assist in settling the "unpleasantness" there. The dynamite guns bring to mind a story of Orpheus C. Kerr, told during the civil war, of a new gun invented by some genius, and called a "double back-action, revolving ferry-boat howitzer." This gun was open at both ends, with a touch-hole in the center. The charge of powder was placed in the middle, and a bushel or so of grape-shot at each side of the powder. The gun was to be placed on the top of a steamer's capstan, that set in rapid revolution and the charge fired, the theory being that the shot would cover an entire circle and kill everyone in the plane of the gun, as well as above and below within range of the "scatter." The inventor presented his gun to the ordnance

board, but declined to experiment with it on the grounds of his having "a large family depending on him for support." There is some impediment of the kind in the case of the dynamite guns, which, so far as known, have never had an ounce of dynamite fired from them.

Professor Randolph, writing of education in technical matters, contends that prices and piece work should be taught. If by piece work is meant contracting with certain men in a shop to produce certain things at stipulated prices, the less taught of this matter the better. It would be desirable to teach systems of piece work, or contract work, in which *all* the men in a shop would participate, and this is easy to do in any case if the managers knew how to conduct such a system. It is simply an advance in methods to know the amount of labor entering into any kind of work done, and as easy to contract a job to the whole shop as to a favored few. We have written a good deal about this matter, not as an ideal scheme, but of facts as they exist. Special piece work, or partial piece work, it may be called, is a weak attempt at the contract system, in which workmen assume the work as their part. The latter is natural, fair and widely different from the paternal idea of "profit sharing." If Professor Randolph will study this matter, and promote education in true piece work it will do no end of good, both for owners and workmen.

ENGINEERING NOTES.

There has been an amusing, and at the same time instructive, discussion going on between *Engineering*, London, and the *Lancet*, the latter the most prominent medical journal in our language, on the subject of boiler explosions, the *Lancet* contending that kitchen boilers are liable to be exploded by admitting cold water into them when red hot. This is a common opinion respecting boilers of all kinds, and is, as *Engineering* contends, a fallacy. Careful experiments made by the Manchester Steam Users Association on both kitchen and power boilers showed that the admission of cold water into them when red hot did not lead to generation of steam that could not readily escape through such safety valves as are commonly provided. *Engineering* not only refers to these facts, but on chemical and by thermal laws shows that explosion of boilers in this

manner is impossible, and such a belief absurd. We think the sooner the *Lancet* draws out of the fight the better. It is on the same grounds that *Engineering* would be in discussing a problem in therapeutics, and has butted up against an inflexible branch of science, fortified by experiment, fact and theory.

What is called Fronde's Law of Increase in the Speed of Ships assumes, as an example, that an increase of one in a hundred, or, as we may say, about four miles a day in the swiftest trans-Atlantic steamers, calls for 2 per cent. of added length, 6 per cent. of displacement, 7 per cent. of horse power and fuel. Compared with the *Paris* and *New York* this increase in the quantities very nearly conforms to Fronde's rules in the *Lucania* and *Campania*. It is hard to realize in the progression of speed the value of the "last knot," and, all speculation aside, there is little doubt that the commercial limit of speed at sea has been reached. Size as a factor may go on, but power cannot well exceed its present proportions. This element acts in various ways against an increase of speed; by the increased weight and strength required for the framing in the engine-room section, increased weight of machinery, consumption of fuel, the life of vessel and its maintenance.

The *Netherlands*, recently constructed for the Hoboken Ferry, at New York, is the fourth vessel of the kind fitted with screws at both ends, so we may conclude that the system has proved itself suited for the particular service there. It does not follow, however, that the same kind of vessel would succeed everywhere. Ferry service is diversified and peculiar. At New York, there is a crowd of vessels to pass, ice in the winter, and runs of several miles in nearly fresh water, deep enough to permit the use of screws, and the form of hulls which screws demand. In the Bay here circumstances are different, there is fouling of the hull to contend with, a difficulty so great as to make copper sheathing essential. Shallow water, and storms that have a run of twenty to thirty miles of free water to work up seas in, still there are some conditions that favor screws for ferry boats. The wheels and their housing are a vulnerable part that receives punishment in regular service, with frequent "jams" that cause a great expense. The wheels have to be either more or less than their normal diameter to get the shafts over or under the traffic.

Messrs. Sulzer Bros., of Winterthur, Switzerland, have recently furnished an engine of 1,300 horse power to a Russian firm near Moscow that, on continued tests, consumes 11.73 pounds of steam per hour for each horse power. A drawing of this engine was given in the *Zeitschrift des Vereines Deutscher Ingenieure*, of Jan. 24th, 1894, where it may be studied by our engineers. Sulzer Bros' works are claimed to be the foremost in Europe in some respects, and we believe they have, for several years past, been ahead of the world in the economy of their steam engines. We have had occasion a good many times to mention these works, and visitors to the Swiss country, such as are interested in machinery, should visit the Winterthur works. The engine sent by the firm to the Centennial Exhibition of 1876 was admitted to be the best fitted among all the examples there. The bright surfaces were all finished by filing, and presented an appearance like satin cloth.

A late production of some interest, is French locomotives with Corliss valves, four on each cylinder, and eight to an engine. This is in the line of a peculiarity of French practice, an aggregation of pieces. In reconstructing a French machine, in England, one half or more of its detail is usually piled away with the scrap. An ordinary French locomotive has at least a third more pieces than anyone else can find any use for, but a locomotive with eight valves and their attendant levers, links, glands, pins and what not, must have delighted the heart of the designer. The little that can be gained by four-valve steam distribution, will be found many times overbalanced by the expense and care of details. One added piece on a locomotive, is a misfortune, a fact that Mr. Corliss himself found when he built the *Advance*, during his early career, and fitted the engine up with his elaborate valve system.

The flexibility of statistics is proverbial, and we confess to a repugnance that keeps them out of INDUSTRY, except in cases that permit verification by analysis or facts. Last month we came near printing some figuring taken from an Asian technical journal, showing that water power electrically transmitted, costs more in Switzerland, than the same power would if generated by coal and steam. Such figuring goes but a little way, compared with the fact that Swiss engineers who are, no doubt, among the most capable in the world to judge of this matter, and especially when the circumstances are

in their own country, go on erecting such plants. They have many of these now, that like Mr. Dudgeon's rotary engine "have run and continue to run" and more are being added. In all mountainous countries the maintenance of water power is not expensive, the fall is great, the volume of water small, and the streams commonly flow over rocky beds. In flat countries where the fall is little, the volume of water great, and plants have to be erected on alluvial land, water power becomes expensive. In Switzerland circumstances are the opposite, and favorable in every way.

There is a popular and mistaken opinion that petroleum oil is an economic or at least a "strong" fuel, having ten times the value of coal or wood. This opinion is a mistaken one. The best that can be done in generating steam in a common furnace is to evaporate about eighteen pounds of water with one pound of oil, while three fourths the same weight of good coal, or half the weight of average coal, will perform the same duty. These are the practical facts based on recent experiments in England, where coal at \$2.50 a ton was used against oil at 8 cents a gallon, the proportion of cost being \$9.25 for oil and \$2.50 for coal. This, of course, does not apply everywhere, and could not in that case have been a fair test or comparison. Of course the main thing is the relative prices of coal and oil, and the difference in the expense of attendance. The oil weighs 8 pounds to the English, or 6.66 pounds to the American, gallon, and if its heating power is one half as much as coal, a ton of the latter is equal to 150 gallons of oil. If any of our readers have any facts it will be a favor to receive them.

The great jetty at the mouth of the Columbia River, in Oregon, is the largest and most important one ever constructed, also has the still greater distinction of having been made for 25 per cent. less than the estimated cost. The work, we need hardly say, was done by the Government engineers, and without contracts. The work is more than four miles long, 15 feet wide on top, and has consumed 6,000 piles that were inserted mainly by water jets, a few blows being given at the end of the sinking with a hammer of three tons weight. The estimate for the work was \$3,710,000, and the cost will be one fourth less. The work is now nearly completed, and has accomplished fully what was intended, giving passage over the great bar for vessels of any draught. The depth of water alongside the

work has been increased from 6 to 20 feet in some places, and 4,000 acres of area have been raised above the water. The Columbia is 1,000 miles long, the only large river on this Coast, and forms the only safe harbor between this City and Puget Sound, 600 miles.

It is strange that no more effort has been made to help electric cars up grades by the descending traffic. If there are two lines, as is nearly always the case, there should certainly be some way of balancing an ascending car with a descending one by means of a cable. To "return" a cable of the kind, the cars would require to be shifted from one line to the other at the top and hooked on, which would, of course, cost something, but it would enable the ascent of steep grades, and would meet the requirements in a great many cases. In the case of moderate grades such as can be ascended by electric motors, and the current "charged back," there is theoretically no loss of energy by grades, but the limit of inclination prevents the construction of lines just in those places where they are most needed. Mr. Kuhlmann's counterbalancing system at Seattle, where an independent weight is employed, has proved a success.

Some people have found fault with Mr. G. W. Dickie for his criticism of engine design in a late paper of his, but it seems that he is not alone in his estimates. Professor Riedler, who is certainly a competent critic, in an address in Germany, sums up our steam engine practice in a rather disparaging manner. Of engines for electric stations he says :

"The engines, however, are throughout extremely imperfect. At the exposition it was seen that American electricians built superannuated types, and that now they are seeking for an engine corresponding to modern requirements, and in the search for it are making experiments which have been successfully solved in Germany six or seven years ago. Even the very best engines of the American central station, which were represented in Chicago, are inferior to the German, and are particularly wanting so far as accuracy of work is concerned."

The performance of a German inverted dynamo at the Exposition attracted a good deal of attention, and by some of our San Francisco engineers was pronounced the best example there, a fact that lends some confirmation to Professor Riedler's views. We, however, think that he has stated the case a little too strongly, but the lesson should not go unheeded.

A correspondent of the *Iron Age* writes to inquire why horizontal wheels are not employed at Niagara, and vaulted chambers made in the rock to contain dynamos at or near the discharge level or just above the tunnel? The inquiry is pertinent, but the idea is not new. This was substantially the scheme submitted by the Pelton Water Wheel Co., of this City, to the commission at London; also is the plan proposed by Mr. Ferranti for the Canadian side, except that in both cases open or impulse turbines were to be used instead of the pressure or enclosed type. It is a plan that yet may be taken up, as the main objection to it was its novelty and a prejudice against impulse or tangential wheels, which are yet but little understood in this country. There are, of course, qualifying physical conditions that may hinder this method, but they have not been made public, if any exist. As it is, the risk taken with the Faesch-Picard wheels is greater, no doubt, than if the true tangential type had been adopted.

Mr. William Cox, C. E., the editor of the *Compass*, and the inventor of various ingenious computing devices, furnishes in the *American Machinist* a new and simple formula to determine the friction head and consequent capacity of water pipes. He first gives the Weisbach formula as follows:

$$H = \left[0.0144 + \frac{0.01716}{\sqrt{V}} \right] \frac{L V^2}{d 5,367}$$

When H = friction head; L , the length of pipe in feet; V , actual velocity of water in feet per second, and d diameter of the pipe in inches. Mr. Cox's formula is as follows:

$$H = \text{friction head} = \frac{L}{D} \times \frac{4 V^2 + 5 V - 2}{1,200} \quad (1),$$

or by transposition:

$$\frac{H D}{L} = \frac{4 V^2 + 5 V - 2}{1,200} \quad (2),$$

which is a simple arithmetical proposition. The author has prepared a table of the values of

$$\frac{4 V^2 + 5 V - 2}{1,200}$$

and has published the whole in the *American Machinist*, of December 28th, working out practical examples of flow, velocity and power by supplemental formulæ based upon the above.

A late number of the *Engineer*, London, gives an account of the great Heilmann electric locomotive recently finished and tried on the Western Railway of France. The locomotive includes a complete generating plant of 600 to 800 horse power, the boiler being 26 feet long and 76 inches diameter, to contain over 11 tons of water. The engines are set athwartship, and are of very novel design, by Mr. Charles Brown, the well-known engineer, formerly with Sulzer Bros., of Winterthur, Switzerland. They are horizontal, one cylinder on each side of the crankshaft, the cranks being 180 degrees apart so as to balance reciprocating strains. The total weight of the engine is 246,000 pounds, carried on eight axles. The maximum speed attained up to the time the description above named was written did not reach 50 miles an hour, which is not very encouraging. It is amusing to read of one man being constantly squirting water on the slide bars of the engines, and another man in oilskin clothing to feel the joints and detect heating, and a third one to apply oil. The whole thing will, no doubt, turn out a blunder.

In a recent number of the *Engineer*, London, there is an engraving and description of a double-barrel bucket pump without valves operated by a crank, the two pistons moving together and called a "continuous-current pump." Such pumps are well known here, and are about as far from "continuous current" as one can well get in pump designing. The current follows the pistons, and the pistons follow the crank, producing in the flow pulsations from a state of rest to a maximum on the half strokes, and, as we have said, is as opposite constant flow as it is possible to get. We have constructed such pumps when younger than now, and know them to be a bad form for any but slow speed. In the case above noted it is amusing to see in the drawing a very large air chamber on the discharge way, a thing not required at all on a "constant-current" pump.

It is reported that the Mississippi River is to be bridged at New Orleans, and that the contract has been let for five millions of dollars, to the Phoenixville Bridge Co., of Phoenixville, Pa. This, unless it be a suspended bridge, will be the most remarkable undertaking of the kind in this country, and is, moreover, unexpected, because the reasons for a bridge there are not clear. Land for railway terminal purposes will cost a great deal on the New Orleans side, and would be very cheap, or as we may say, is cheap, on the

Algiers side. The river is narrowed at New Orleans, and must be at least 100 feet deep, with a sedimentary bottom, and piers will be impossible. The main object of such a bridge must be inter-communication. The Louisville & Nashville, Cincinnati Southern, and Illinois Central are on the Orleans side, and the Southern Pacific connections and terminus are on the Algiers side, the passengers for the latter named line being carried by a ferry, as here at San Francisco.

The American Engine Co., at Bound Brook, Pa., about two years ago began wasting good workmanship and material on some kind of a swash-plate engine with roller bearings and other vices. We had the temerity to say so at the time, and to predict that the company's efforts, which seemed to be in a constructive way good, would soon be directed to some other form of steam engine. This prediction has become verified, and a well-designed, well-framed, high-speed engine of the reciprocating type is now advertised by the company. The cut-off is on the Rider system, by turning the main valve, to which we can see no objection if the mechanism can be made thoroughly durable. The eccentric strap is set obliquely on a shell surrounding the eccentric, and this shell is turned by the governor to effect regulation, the traversing motion of the valve remaining constantly the same, and thus not interfering with the exhaust function.

The steam turbine is coming on. The London School Board, a very conservative body, has contracted for an electric plant of 100 horse power, in which the motive power is Parsons' steam turbines. This is the first case, so far as we know, where a complete land installment of the steam turbine has been made, but it is not likely the last one. The subject is one of engrossing interest at this time, among as many as have given it thought, and its commercial importance will follow soon, if there appear no impediments to a fair economy. This class of engines will be the subject of systematized and concentrated manufacture, because the accuracy of fitting required is such that the work cannot be well done in a common machine shop, but the engine itself is a small matter compared to one of the reciprocating kind, the weight being, at a guess, one tenth as much. Farther data respecting the working of the plant above named will be forthcoming soon.

MINING.

NOTES.

The "gold saver" takes to precipitation methods with as much regularity as the perpetual motion man does to rolling weights. He knows that gold is eighteen times as heavy as water, consequently will sink faster than any other material, and on this assumption he proceeds to construct apparatus to carry out his "idea." That surface is the retarding element, and this does not bear a constant relation to volume or weight, is not taken into account. Neither is the still more practical fact that the laws that govern precipitation are not a matter of discovery or conjecture, but are so well demonstrated as to furnish the elements of formulæ. Mr. Luther Wagoner, of this City, some years ago made some very careful and extended experiments to determine the rates of precipitation for fine and flake gold. These experiments are preserved in formulæ and rules that if understood would save a good deal of lost effort. We do not assume that the gravity of fine gold may not be a means of separation, but not very successfully by direct precipitation in water.

Mr. J. E. Fraenkel contributes to the *Forum* for February a carefully prepared essay on the production of gold, and almost at the beginning quotes Prof. Soetbeer as an acknowledged authority who has shown that during 1880 to 1885 only 25 per cent. of the gold procured was coined into money, a fact we commend to those who think the value of coin is given by "stamping it." At the present time the writer's estimate is that the production of 1892, amounting to \$138,000,000, \$75,000,000 worth was used in the arts, and \$63,000,000 for coins. Another fact of importance brought out by the author is the enormous increase of bank holdings of coin. In 1880 this was 453 millions, in 1890, 680 millions, and 1893, \$1,023,000,000, showing an absorption of 343 millions into a static fund, it may be called. This equals the product of three years during the decade named. The product in 1892 Mr. Fraenkel places at 138 millions, divided more equally between countries than any other product that can be named, as follows: United States, \$33,000,000; Australia, \$33,000,000; Africa, \$25,010,000; Russia, 24,709,000, all other countries about \$21,000,000.

A contemporary explains that in the new copper mines to be opened near Butte, Montana, pumps, hoists, drills and railways will be driven by electricity. The words are: "Steam power will not be used around the mines for any purpose." It is this method of speaking that leads to a false impression respecting electrical apparatus, which does no more than convey or transmit power. In the Clarke mines, for example, the motive power is, or will be, a prominent element, and its transmission a secondary matter if the power is generated at the mine, but of the source from which power is derived there is no mention whatever, the inference being left that there is only electrical power. This may not be a very important matter in so far as readers who are acquainted with the subject, but in the end it will re-act against the the electrical interests, indeed has done so in many cases heretofore where similar statements have been made.

It is encouraging to see that, notwithstanding the balky start made in lincensing the hydraulic mines, the system seems now to be going on with much success. As soon as three or four mines made a start, the others followed, and now it may be said a general licensing is in progress. What difficulties may arise in future is the main question. The Commission is, happily, one that cannot be purchased or influenced, and any infraction of the rules or conditions of the licenses will soon lead to summary action on the part of the Government officers. On the sixth of March the board licensed five mines and received applications for licenses from five more. It is difficult to understand how inspection and the necessary preliminary work can be managed, but this we presume can follow in most cases, the miners taking the risk of their being within the terms of the Act of Congress under which the licenses are issued.

The Union Iron Works led off about two years ago in making iron frames for stamp batteries, furnishing a number of this kind for a mine in Bolivia, and it will not be a surprise if in future they continue to use iron for frames in most cases. When made of iron the whole structure is erected and completed in the works, and millwright work very nearly dispensed with. In England battery frames are always made of iron, and were it not for the remarkably fine timber obtainable here, it is likely that iron frames would be more common. It must be remembered, however, that in other

countries different circumstances exist, and the works here, to compete successfully, should be prepared with drawings, if no more, from which tenders can be made when estimates are to be sent out to other countries. We note that the wooden driving drums remain on the iron stamp mills. This is not in keeping. Almost any draughtsman can design an iron pulley as elastic as a wooden one.

Mr. Charles E. Hegard, a skilled mining operator, of Quincy, Plumas County, California, recently turned out a small bag of nugget gold on our desk, that made a profound impression. One lump contained \$20.00 worth of gold, and many more came near it. This is not, however, the main matter to be noted here. Mr. Hegard contends that owing to the roughness of the country and heavy snow fall in winter in connection with bad roads, has prevented the development of gold mining in Plumas County, to the extent that it should be carried on. The Feather River, that has its rise in the high lands of that County, gives evidence throughout its length of the auriferous nature of its washings, and there is no doubt that in the region around the head waters of the three forks of this river, there are opportunities for profitable mining, not excelled in this country, and a field that in future is to receive much more attention than in the past. Plumas County, Mr. Hegard claims, has been overlooked and neglected as a mining region.

One of our noted engineers, in a recent conversation, remarked: "The number and extent of old river beds beneath the lava caps of the Coast Range of mountains is not even conjectured, and the future of gravel mining may be the greatest fact in gold procurement, for the Pacific Coast at least." Supposing the rainfall of ancient times to be as much as now, and there are reasons to believe it was more, there must certainly be thousands of miles of buried channels yet undiscovered. This view is strengthened by the fact that the discovery of these channels is dependent on some part of them being bared by erosion, and their course conjectured by various signs and conclusions that are all the time being better understood, but furnishing no clue to channels wholly obscured. It is singular that so little boring is done in searching for these gravel drifts. There is a company in Chicago that bores holes by contract in all parts of the country, and it is a wonder that there is not such a company or firm here, operating with diamond drills.

A "calculating" man who will go into the Sutter Creek district, Amador County, and hear from the people there a description of mining methods on the Mother Lode, when the mines in that region were abandoned, or many of them abandoned, and compute the difference between then and now, in gold saving, power and expense of all kinds, must come to the conclusion that reopening these mines is a safer venture than embarking in new fields that are unexplored. We need not point out that many mines have been successfully reopened in the Sutter Creek and Jackson district, the Wildman for one example, situated directly in the romantic little town of Sutter Creek. The great impediment to farther development in this district is means of communication, and it is wonderful that with the amount of freight and travel, that a railway of some kind has not been made up the valley from Ione.

MISCELLANEOUS NOTES.

Steam ships, like all other things, can be made in many ways, and of varying quality. The *Britannic* and *Germanic*, of the White Star Line, built in 1875, have each made 200 round trips between Liverpool and New York, carried 360,000 passengers, and have made a mileage of 1,500,000 without accident or detention. These ships are now as good as ever, and could not be purchased for less than nine tenths of their contract price as new vessels. About two years ago circumstances called for a valuation of the *Oceanic*, now in service from this port, and it was found that her cost would be much the same as it was in 1870, twenty-three years ago, when she went into commission. These ships were built by Harlan & Wolff, at Belfast, and are, perhaps, no better than some turned out by other firms, but are certainly above average in quality.

One of the White Star steamers, the *Cevic*, on one of her late trips outward from New York carried 14,000 tons of freight, mostly of a valuable character, reaching over half a million of dollars. The construction of freight steamers for the American or International Line, and their success in several of the British lines point unmistakably to a future division of the traffic into two classes, not only on the North Atlantic, but wherever a large trade exists. The element of time is important in the case of mails and passengers,

but only in a limited degree as to freight, when the difference does not exceed six hours a day, or twenty-five per cent. The difference in fuel is a half or more, and fuel forms the principal expense, because the coal must have the cost of carriage added to its original price. The crews have to be paid more wages on the slower trips, but a smaller crew will do, and the wear and tear is enough less to compensate for most of the difference in wages.

There was launched about two months ago a steel sailing ship of 4,500 tons from the yard of Messrs. Sewall, in Bath, Maine. This ship is of the highest class in every respect, and was designed by Mr. Waddington, who was for a long time engaged with Messrs. Harlan & Wolff, at Belfast. The vessel is 310 feet long, breadth 45 feet, draught 22 feet 6 inches, and we trust is not the last that may come from the same source. The steel clipper ships seem to have all the business to do at this port, and for good reasons. The difference in underwriter's rates will alone give these vessels a kind of monopoly. The *Dirigo*, the ship above described, has been built for foreign trade alone, and the owners will be entitled to a drawback on the duties paid on the material, which it seems was imported, most of it from Glasgow.

There are 13,200 sheep owners in New South Wales, and 750 of these own 62 per cent. of the sheep, the flocks being from 20,000 to 500,000 head. The total number of sheep is set down at 59,464,000. The breeds are of the finest, being largely of the Merino or long-wool kind, with various cross breeds. There is land galore, and this, with the favorable climate, accounts for the enormous wool product of that country. The exhibits from Australia and South America at the Chicago Exhibition taught our people a good deal concerning wool and sheep raising, and that we could not successfully manufacture woollen cloth without these fine wools.

It will be news to most people on this Coast to learn that Indianapolis, Ind., is in proportion to population the greatest consumer of natural gas. Recent statistics show that 27,000 families and offices use gas for heating purposes. The wells are 21 miles distant, and the main pipe lines 40 miles long, supplied from 21 wells. There are in all 40 wells, and the custom is to change them, and thus allow a period of rest for recuperation. The "life" of the

wells seems to be about eight years, but the time is not yet long enough to determine this fully. Indianapolis is situated on a great plateau between Lake Michigan and the Ohio River, and there is no more reasons for finding natural gas there than in a hundred other places in that region, or in any region we may say, where the earth's stratification is regular and horizontal. At Lima and Findlay, Ohio, great deposits of gas have been tapped, and to a great extent "drawn off." At Findlay, at least, there has been an exhaustion of the gas supply.

In the valley of the Arkansas River, west of Pueblo, at Florence, Col., there is an oil district where the *Mining Industry*, Denver, says the amount of oil raised daily is 2,000 barrels. The oil is procured at depths of from 1,400 to 2,100 feet. The oil companies have an aggregate capital rated at \$4,000,000, that might perhaps be divided by five. A new refinery has been completed, and as the supply has kept up for eight years the business may be regarded as a permanent one. In Wyoming oil fields will, no doubt, be discovered, because of the coal there, and it is probable that the Rocky Mountain region may, at some near time, supply the country to the west at lower prices than now have to be paid.

There is over the Tennessee River, at Knoxville, an aerial ropeway a thousand feet long, to carry passengers across the river. The car, which runs on two cables, is at some points 350 feet above the river, and the trip is very much like going up in a balloon. The car weighs 1,200 pounds, and accommodates sixteen passengers. The cables are $1\frac{3}{8}$ inches in diameter, two of them, capable of withstanding a straining of 60 tons. In February an accident happened by the breaking of the hauling cable, which gave way just as the car reached the highest end, and this let it run back at a high velocity. The brakes stopped the car before it reached the terminus, but one man was killed and a woman frightened into madness. From some views of the plant, given in the *Railway Review*, there seems to be a danger not mentioned, that of small trolley wheels. These should be as large as possible, because the bending action, no matter how obtuse the angle, is as the arc of the trolleys. With proper precaution there is no reason why these aerial ways cannot be made safe and highly useful.

U. S. Consul James B. Taney, writing from Belfast, says an American firm, Messrs Sloane, sent 40,000 rolls of American-made carpet to Great Britain, which caused a great commotion there, and a fall of 10 to 20 per cent. in the price of Axminster and other fine grades. This we presume was done by a drawback on the wool, but even then it is a significant fact. The English makers instead of clamoring for a tariff have set out on the more sensible course of producing cheaper and lowering their own prices to meet the competition, and propose a reduction of "40 to 50 per cent." In this we suspect the Consul is mistaken. Thirty or even twenty per cent. in the price of carpets is a phenomenal reduction. It is fair play, however, and leads to permanent results. The consumers, a larger and more important part of community, gain the advantage of low prices. Not only is the manufacture spurred ahead, but is improved and made permanent, if not, the makers will get but little sympathy from English buyers.

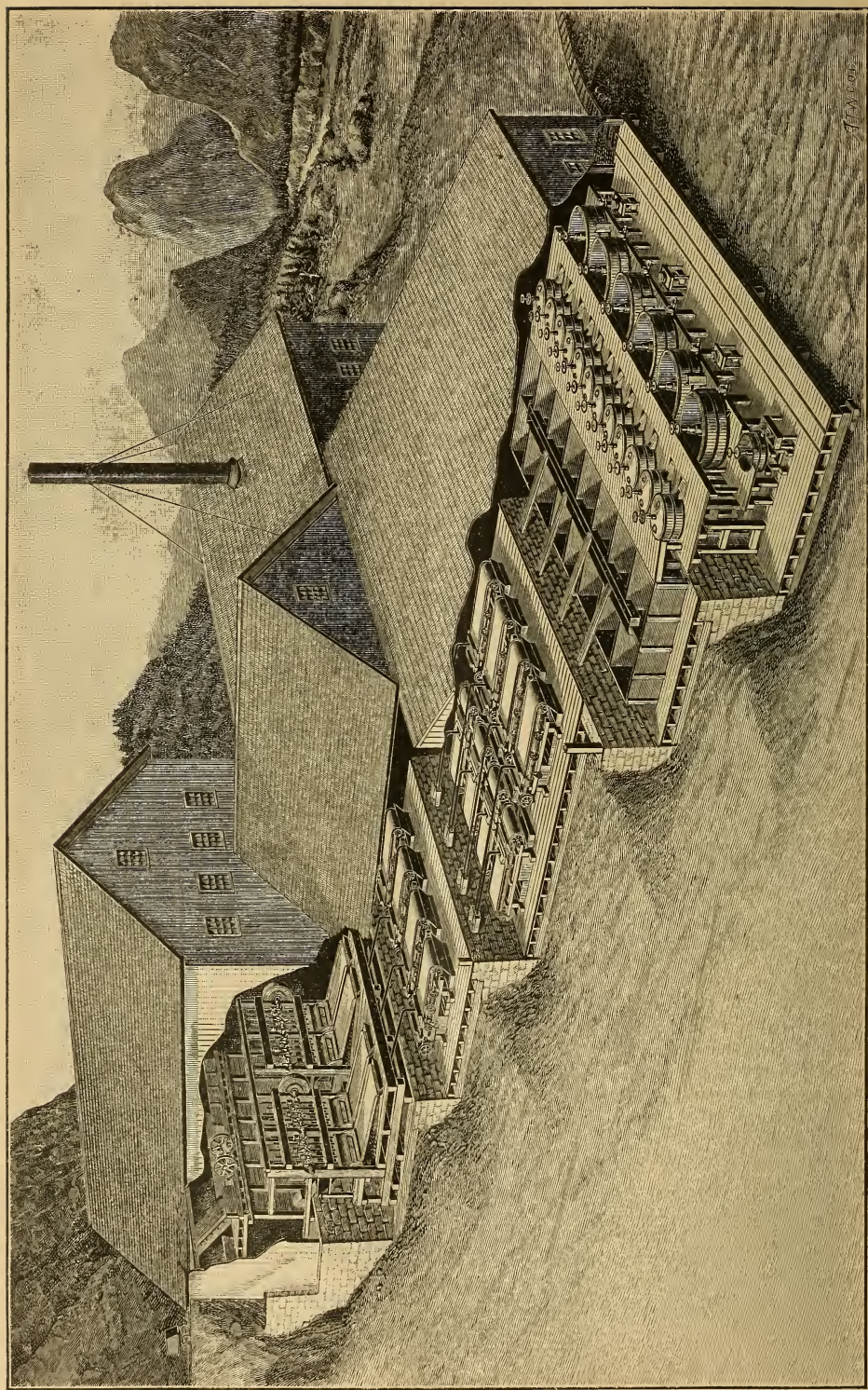
Mr. Albert Stetson, at the late meeting of the American Institute of Electrical Engineers, at New York, read a paper on the practicality of the conduit system for electric railways that is exhaustive and impartial, if we except the fact that the standard assumed is "commercial" throughout, especially in respect to cable roads. Of these the author says "it is probable that no more will be made." This is a problem of grade and not of cost. Cable roads are, we imagine, to remain so long as there are no better means of climbing steep gradients and utilizing the gravity of the descending traffic, but this aside we think Mr. Stetson is wrong in his premises by setting up a standard of profits alone to indicate the survival of any system. There are two sides to this question, one the railway owners' side, the other the public, and both must be considered. It is not alone a problem of how much a railway company can earn, or even at what rate passengers can be carried, public rights, convenience and safety should also be considered.

The *Engineering and Mining Journal*, of March 3rd, contains an article on Lake Superior iron ores, stating that a contract has been made to deliver 90,000 tons at Chicago for \$2.75 per ton. The components of this price are worked out, allowing railway freight at the rate of 70 cents per ton from the mines to Ashland, the Lake port

from where the ore is shipped to the main points of consumption. This amounts to a rate of $1\frac{3}{4}$ cents per mile ton, and, as the editor remarks, can be compared with the rate in Alabama of one half cent per mile ton or ton mile. Considering the wonderful facilities for handling ore at the Lake Superior mines, and the level country over which it is afterwards hauled, there is here a point of much significance, a proportion of 2 to 7 in railway rates. Even if the Alabama rate is doubled there would remain a query as to whether the southern roads were losing money, or the northern lines exacting an unreasonable rate. The royalty is set down at 30 cents a ton, which is also unreasonable.

There was sometime ago, a reported discovery of coal in Mendocino County, California, that most people set down as the usual newspaper item, but it seems there is more than this in the case. A coal district about fifty miles from Ukiah, owned by the Mackay-Flood combination, gives more promise of a local coal supply than the Diablo mines. We were near these Mendocino County mines a short time ago and heard the usual wondrous stories of the coal and its quality, but supposed it would turn out as in other cases mainly a myth. The only hope of any public advantage lies in the production of enough coal to effect the market here, and this can hardly be expected. San Francisco, although in a mild climate, where heating should not consume much fuel, is nevertheless a heavy consumer of coal in proportion to population. As a rule climate has little to do with heating. The coldest countries consume no more fuel than temperate ones, but they use it in a different way. The Mendocino supply will be exploited during the coming summer.

In another note is mention of some ludicrous translations from English technical terms, but the French are not to blame. "Feed pump," for example. Why "feed?" This term indicates "aliment." Certainly "supply" is a better name. "Donkey boiler" also, or "donkey engine." What has either to do with donkeys? Smoke "stack," steam "chest," "pitman," "breaching," "blow-off," and many other of our names, do not translate very well. In time these will give way to relevant names or arbitrary ones that do not have other meaning. Twenty years or more past have almost turned rail-"road" into rail-"way," and transposed the terms "station" and "depot," not in imitation of British terms, as many claim, but on grounds of relevancy and grammar.



TWENTY-STAMP GOLD OR SILVER MILL.—THE UNION IRON WORKS, SAN FRANCISCO.

"INDUSTRY."

JOHN RICHARDS, EDITOR.



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TWENTY-STAMP GOLD OR SILVER MILL.

THE UNION IRON WORKS, SAN FRANCISCO.

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The drawing on the page opposite is one of the most complete that has been prepared to illustrate the practice of this Coast in constructing gold and silver mills, and is arranged for both concentrating and amalgamating processes, or a combination mill. As a technical description of the processes involved would be understood only by those acquainted with mining matters, we will, contrary to the usual custom, attempt to convey to our readers such explanation of the operations as is possible in connection with the drawing.

The two common processes for the reduction of mineral ores are milling or crushing, and smelting or melting in furnaces. In the latter process the ore is reduced to a fluid state by heat at a temperature of 3,000 or more degrees, the combustible matter burning out, and the bullion, commonly in conjunction with lead or copper, settling to the bottom by reason of its weight, the gaine or melted stone running off as slag.

The milling or crushing process, as here illustrated, consists in successive operations to reduce the ore to a fine powder or "pulp," as it is called, and finally to "slickens," an impalpable "mud," the gold or silver being caught or selected by mercury at each stage,

except in concentrating processes, where gravity is the cause of selection or separation, as will be hereafter explained.

The mills, whenever possible, are erected on a slope, so the material will descend by gravity from one apparatus and process to another, and finally flow away clear of the plant into some stream or impounding place, some of it, the "slickens" is carried in suspension hundreds of miles to the bays or ocean where it is deposited as veritable mud, the most tenacious earth slime that exists.

Beginning at the highest point, the ore is received usually by cars, one of which is seen in the drawing, and is dumped on the inclined chute at the top, and lands on a platform, from where it is shoveled into the rock crushers after the large pieces, if any, have been broken with sledges.

The rock breakers or ore crushers consist of powerful jaws that have a reciprocating motion, coming nearer together as the ore falls down until the pieces are from one fourth inch to an inch in one dimension, depending on how the machines are adjusted. The crushed ore then slides down to the "feeders;" apparatus having a nice adjustment so as to deliver a definite amount to the stamp, controlled generally by the depth or quantity in the batteries. These latter form an important part of the mill plant. There are usually five stamps in each battery, weighing with stems and attachments in California mills about 800 pounds. These are merely gravity hammers, lifted by cams, and falling from 6 to 10 inches 80 to 100 times in a minute, delivering 500 blows in that time in each battery. These crush the ore to a fine sand or pulp so it will by the splashing of the water find its way through perforated screens seen in front of the batteries at the bottom. In this operation gold catching begins. Quicksilver being supplied to the battery amalgamates with the free particles of gold detached by crushing, the "amalgam" settling to the bottom by reason of its weight, or passing out through the screen where it is caught by the inclined silvered plates reaching from the batteries nearly to the edge of the platform on which they stand.

The roar and jar of these batteries is terrific. The blows in the mill shown would be about 2,000 per minute, while the crashing, splashing, knocking and general turmoil suggests an infernum, less the brimstone feature.

The pulp or sand and water running from the catch plates flows next to the first row of concentrators on the platform below the bat-

teries. These consist of wide bands or aprons, usually of India rubber, set at an inclination and moving slowly "up hill," a thin stratum of sand and water flowing the other way. This is to catch the sulphurets, black sand or pyrites that by reason of greater weight do not roll or wash off with the sand, but are carried backward up to the highest end of the band beyond the water and pass over the end, falling or washing off into a tank beneath. These sulphurets have to be treated by heat and chemical processes, the most common being by "chlorination."

From the first concentrators the pulp flows down to the next double set of similar machines, where farther and more diffuse treatment extracts more sulphurets, and the tailings flow into the settling vats on the second platform from the bottom. From here, after settling, the material is shoveled into the amalgamating pans on the same level.

These are grinding or mascerating mills, the process being very like grinding grain. Here the mercury-catching process is renewed, quicksilver being put into the pans with the pulp, so as to become incorporated with the gold or silver, producing what is called "amalgam," a spongy mass of mercury and gold, or silver, that when formed is washed out with the pulp into "settlers," the circular tubs at the bottom, where this amalgam is allowed to settle in a pocket at the center, and is removed.

All that now remains to be done is to "retort," or volatilize the mercury by heat, so it will pass off as a vapor, leaving the silver or gold almost pure to be cast into ingots or bars. The mercury is condensed, and carefully saved for use over and over again.

A mill may consist of concentrating processes alone for extracting the precious metals, or may operate by amalgamation alone. There are wide variations, depending upon the character of the ore and the many substances that are present with it.

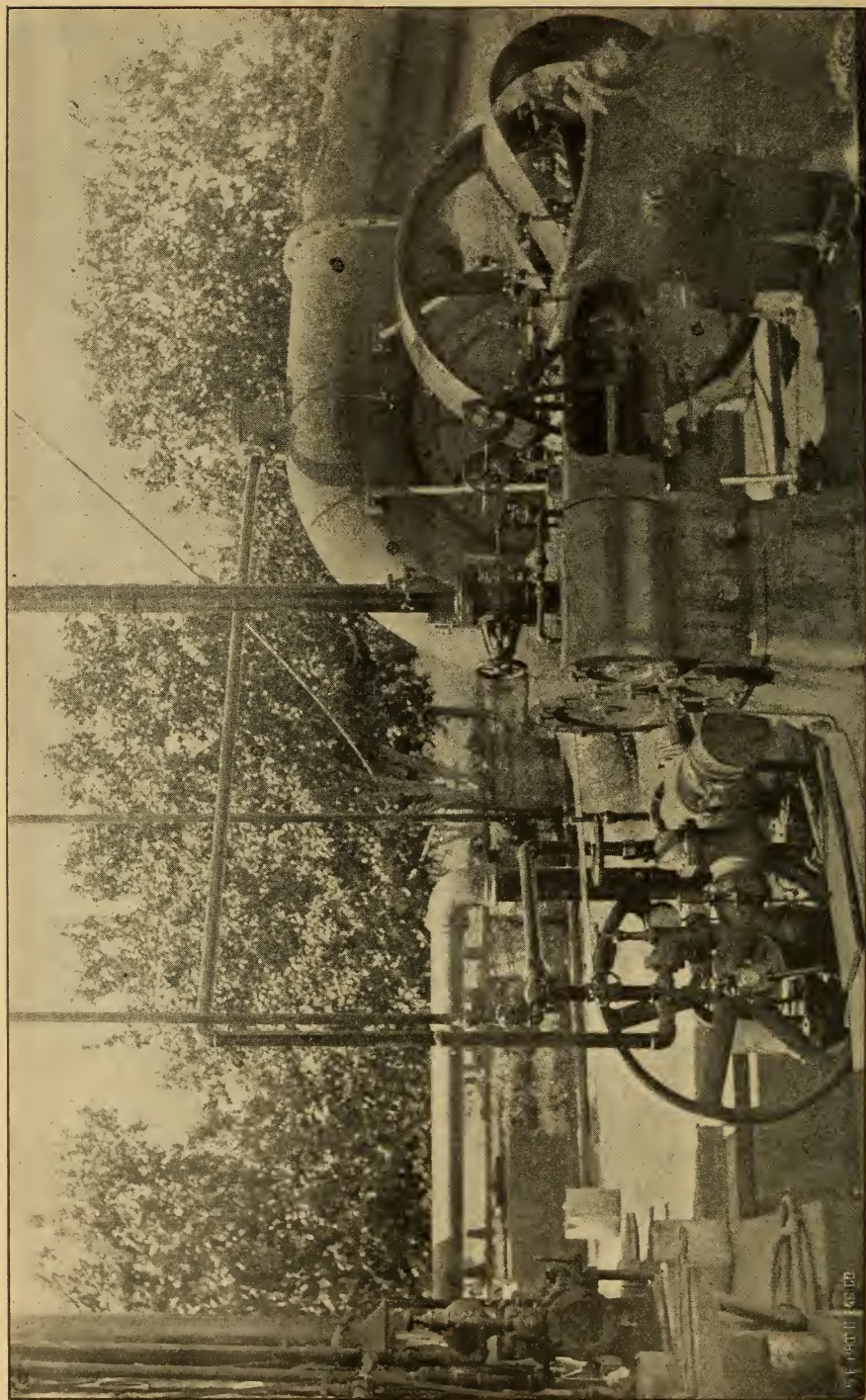


FIG. 1. 100 H. P. PUMPING PLANT, RANDALL ISLAND, SACRAMENTO RIVER.—BYRON JACKSON, SAN FRANCISCO.

RECLAMATION MACHINERY ON THE PACIFIC COAST.

The writer of this article, about six years ago prepared a paper on the subject of "Irrigating Machinery on the Pacific Coast," and at that time was able to claim that in many and important respects the methods of raising water for irrigation purposes, especially from pits and wells, was a marked advance on practice elsewhere.

This paper was presented before the Institution of Mechanical Engineers, in London, in 1888, and was published in the Proceedings for February of that year. It was extensively noticed through the technical journals of various countries, because of the novelty and success that attended on the methods described. Principal among the features treated upon in this paper was the adaptation of centrifugal pumps to the varying conditions of irrigation, with but slight mention of reclamation machinery for raising large volumes of water from overflowed lands. Since that time reclamation machinery has formed an important part among the engineering enterprises of the Coast, and we have applied to Mr. Byron Jackson, of this City, for some particulars of his practice, he having erected many of the draining plants now in use in the Sacramento and San Joaquin valleys.

The data sent will have especial interest because of their being taken from machinery now in operation, and the efficiency computed from actual working results, the construction and arrangement diverging in many respects from European practice. We mention European practice because there is not much done in this branch of work in the Eastern States, and such as is done when not copied from English makers, or practice here, is scarcely of a class to admit of fair comparison.

In Figure 5 is shown the type of steam engines employed by Mr. Jackson to operate his large centrifugal pumps. These engines embrace a number of novel features of arrangement, as may be seen. The single distributing valve is placed beneath the high and low pressure cylinders, and performs steam distribution for both. The arrangement is good, perfect drainage being attained, while the motion-rods and actuating gearing, as well as the valve, are perfectly accessible.

The valve is shown in the diagram, Fig. 2, *A* being the high-pressure and *B* the low-pressure one, the exhaust steam passing out at *C*.

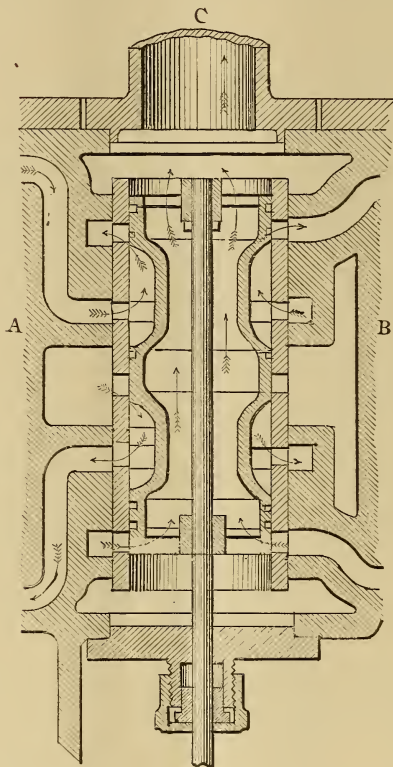


FIG. 2. SECTION THROUGH THE ENGINE VALVE.

These valves form the subject of a recent patent of Mr. Jackson's, the nature of which can be explained by the following quotation from his specification :

"My invention consists in arranging such engines as close together as practicable, and in the intersecting curves of the cylinders placing a piston valve of peculiar construction as near to, or as near in the plane of the cylinders as is most convenient, and in so constructing these piston valves that the central piston thereof will perform the function of admission for both ends of the high-pressure cylinder, and so the two end sections thereof will perform the release of steam from the high-pressure cylinder, and both admission and release for the low-pressure cylinder."

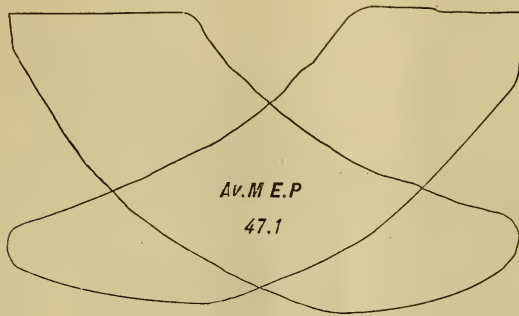


FIG. 3. HIGH-PRESSURE CYLINDER.

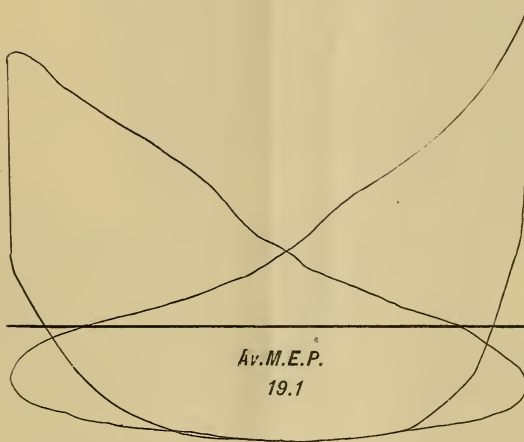


FIG. 4. LOW-PRESSURE CYLINDER.

The claims fully cover this form of valves, and the indicator cards in Figures 3 and 4 show the result in steam distribution. These cards, of which the originals were sent to engrave from, show a result that fully warrants this arrangement for pumping engines, or for any purpose, when so much is saved in the way of simplicity and compactness.

Figure 6 shows one of these compound engines connected with a centrifugal pump of 30 inches bore. The drawing is from a photograph taken from a recently constructed plant for a constant, or nearly constant, head. When the head varies much, as is common

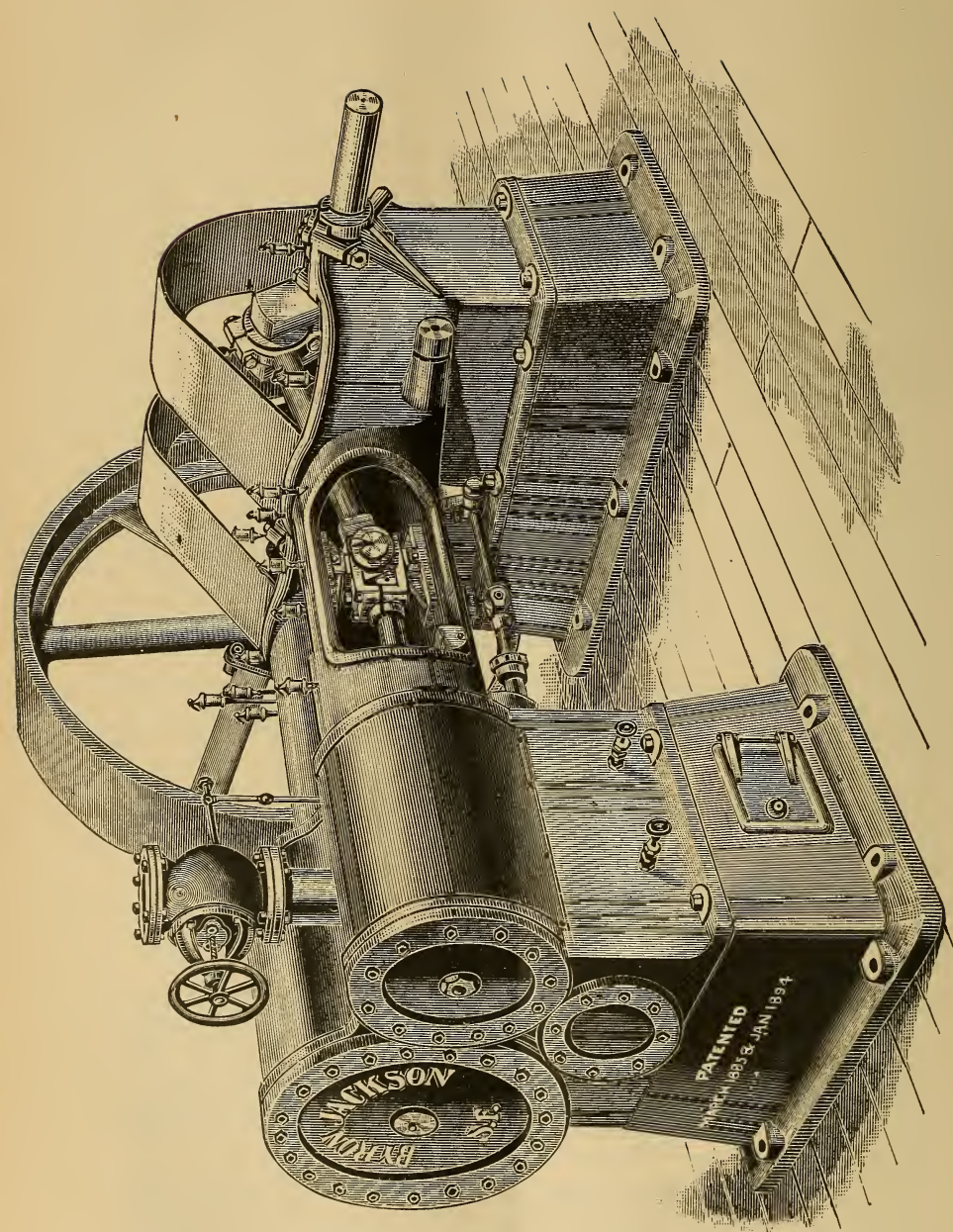


FIG. 5. SINGLE-VALVE, CROSS-COMPOUND AUTOMATIC STEAM ENGINE.—BYRON JACKSON, SAN FRANCISCO.

in drainage works, owing to the rise and fall of the rivers and consequent discharge level, two pumps are employed instead of one, so that either pump or both can be operated with the same engine, as the head and quantity of water may admit.

It will be noticed there are no sole plates or continuous framing shown. This is the result of a novel method, which so far as we know, Mr. Jackson was the first to adopt, that of constructing a continuous frame of wrought iron channel bars, that is buried in the concrete foundation flush with the floor, all the parts being bolted to this frame. This, besides forming a very rigid foundation, saves tons of iron and a corresponding amount in the first cost of a plant. All the possible functions of a continuous cast-iron sole frame are thus attained, because the concrete work is the true element of stability, and the connections, by reason of the buried channel bars, are much firmer than with "bedded frames" bolted down "on" the masonry.

The centrifugal pumps we will not attempt to describe, except to say that the diverting or throat plate, which according to the "Parsons Experiments" added a third or more to pump efficiency, is omitted. The space at command, as well as the want of necessary diagrams, will prevent us from entering upon this subject here, any further than to say that the function or effect of these cut-off throats is much over-estimated. The problem is an intricate one in every way, not susceptible of analysis mathematically, because the flow or path of the water in the pump, and the friction between the convolutions of water, one upon the other, cannot be assumed,

The impeller or wheel is inserted at the side, the main casing being in one piece, and the water enters at one side, as it should in all draining pumps, not only to avoid angles, but obstruction from tule roots, grass, bean straw, and other debris that must pass through the pumps.

Fig. 1, on page 266, shows an elevation of a recently constructed reclamation plant, erected at Randall Island, on the Sacramento River, from a photograph taken before the buildings were erected, but after the pumps were at work.

A remarkable feature of this plant is the absence of detail and extreme simplicity of design. The air and feed pump, condenser, and indeed all the supplementary machinery is grouped near the main engine like the "Doctor" on a western steamboat. Everything is within reach, and the space covered is not more than one half as much as in the older plants of equal capacity.

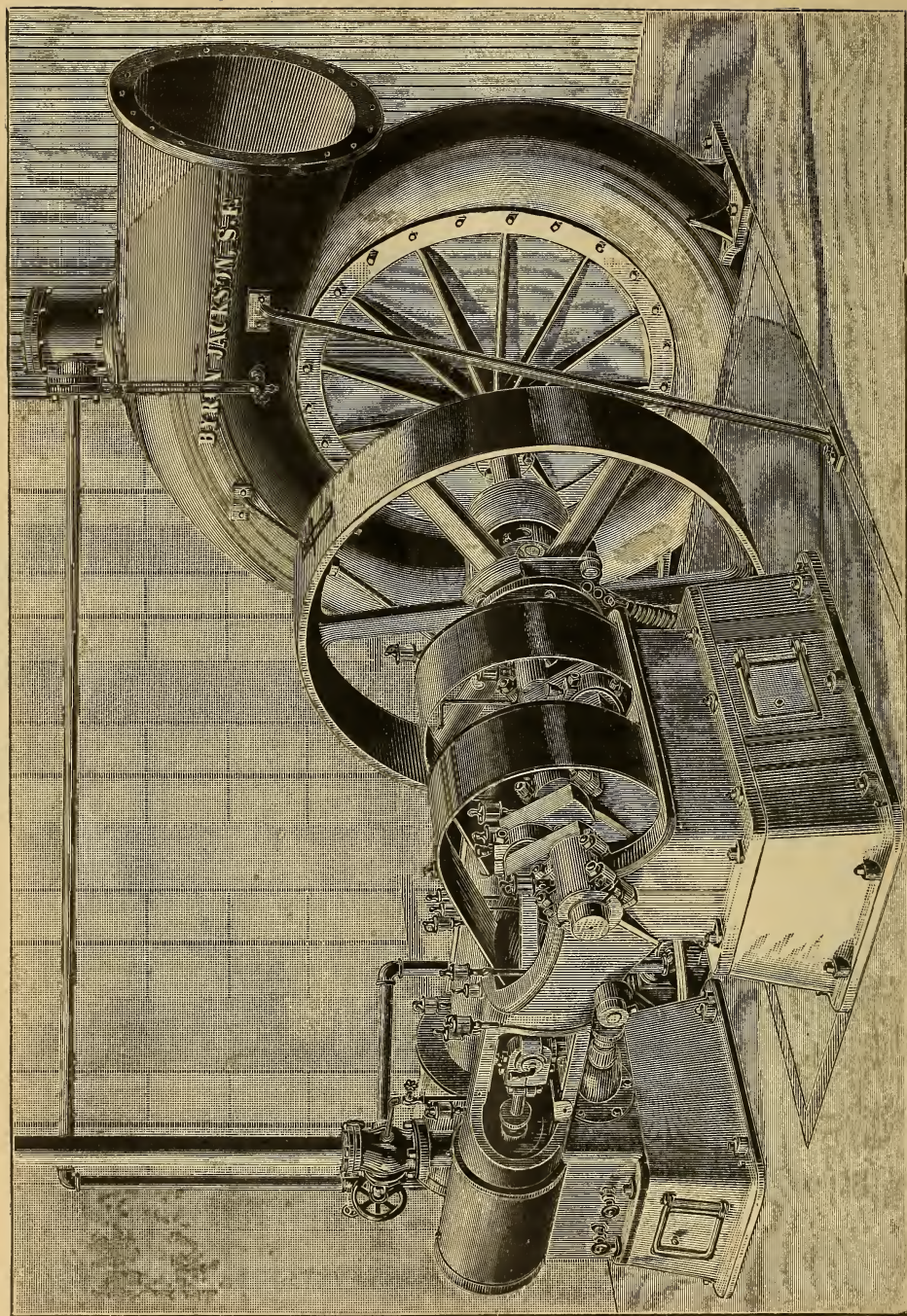


FIG. 6. 100 H. P. SINGLE-VALVE, CROSS-COMPOUND ENGINE, AND 30-INCH CENTRIFUGAL PUMP.
BYRON JACKSON, SAN FRANCISCO.

The arrangement is better shown in Fig. 7 from a photograph of a plant of 200 horse power, and pump of 44 inches bore, taken at the works recently. In this case the machinery is still more condensed as to space and detail, the condenser, air pump, feed pump, and attendant details, being brought within a quadrangle of about 18×18 feet. This plant has been recently tested at Grand Island, in the Sacramento River, by Mr. J. W. Ferris, C. E., of this City, and chief engineer of the reclamation works on the island, and of district No. 3, Sacramento County; Mr. Perry, of Mr. Jackson's works, assisting.

We condense the following from data sent by Mr. Jackson, taken from the trials of the machinery when it was started. It is highly satisfactory, but a higher efficiency can be expected in future tests that will be made.

The engine was of the cross compound type as shown in Fig. 5, the cylinder being $13\frac{3}{4}$ in. and 25 in. diameter, with a stroke of 16 inches; steam pressure, 120 pounds per inch; vacuum, 27 inches; number of revolutions per minute, 160; indicated horse power, 210. The boiler was 16 feet long, 66 inches diameter, return tubular, with 78 flues $3\frac{1}{2}$ in. diameter, 16 feet long. The heating surface amounted to six square feet per horse power developed; grate area 25 square feet. The horse power was computed from 30 sets of cards giving for the high pressure cylinders 47.1 pounds M. E. F., and for the low pressure cylinder 19.1 pounds M. E. F. The water consumption, estimated from volume of steam and terminal pressure in low-pressure cylinder, was $12\frac{1}{2}$ pounds, and coal consumption 450 pounds per hour. The working results are given as follows, with a summing up at the end:

	Feet.	Inches.
Diameter of pump shell.....	12	..
Diameter of pump runner.....	4	10
Diameter of suction pipe.....	..	44
Diameter of discharge pipe.....	..	44
Discharge end of pipe under water in river, forming siphon.		
The difference of water level was.....	10	3
The friction head due to horizontal length of pump pipes (275 feet).....	1	6
Height of lift.....	11	9

To measure the cross section of the canal leading to the pump, lines were stretched across 50 feet apart for 200 feet, and measurements taken with a pole (having a foot piece 6×8 nailed on) at every foot.

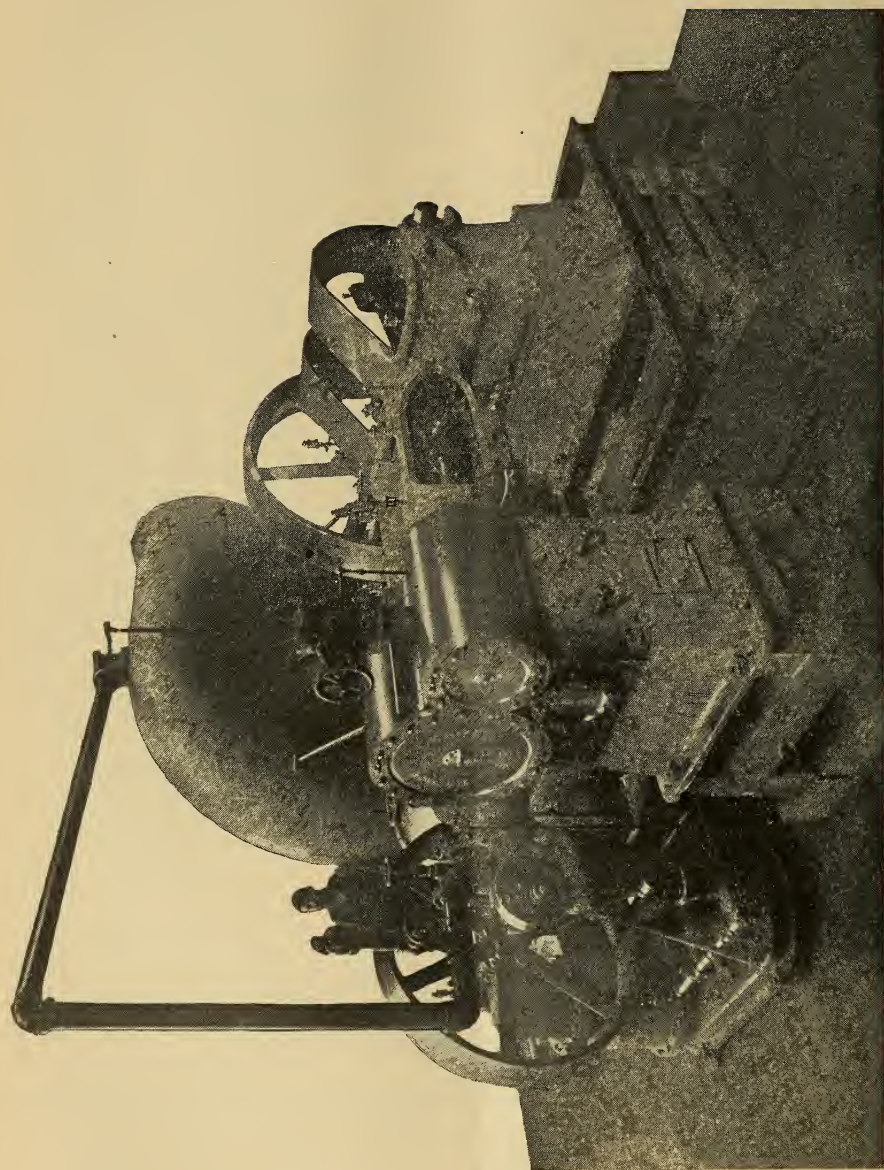


FIG. 7. 200 H. P. RECLAMATION PUMPING PLANT.—BYRON JACKSON, SAN FRANCISCO.

The average depth of canal..... 6.32 ft.
 The average width of canal..... 27.166 ft.
 $27.166 \times 6.32 = 171.69 =$ average cross section of canal.

The velocity of the current in the canal was measured by a float consisting of a pole, weighted to make it stand vertically in the water, with its top three inches above the water line and its bottom just clearing the bottom of the canal. In an average of several trials, the float traveled the 200 feet in 337 seconds = .593 feet in one second = 35.58 feet per minute. The velocity of the weighted float was an average of $8\frac{1}{2}$ per cent. less than that of the surface float in the center of the canal, and a further deduction of $8\frac{1}{2}$ per cent. for side friction (making a total deduction of 17 per cent. from the center surface velocity) would give $35.58 - 8\frac{1}{2}$ per cent. = 32.56 feet per minute. Average velocity of water in cross section 171.90 (cross section) = 32.56 (velocity) = $5,590$ feet per minute. $5,590 \times 7.5$ (gallons per foot) = $41,925$ gallons per minute. $41,925$ (gallons) $\times 8\frac{1}{3}$ pounds per gallon = $349,375$ pounds $\times 11.75$ (height of lift in feet) = $4,105,156$ pounds lifted 1 foot high, which divided by $33,000$ (mechanical horse power) = 124.4 horse power. 450 pounds of coal per hour, divided by 124.4 (horse power) shows coal consumption to be 3.6 pounds per hour for each actual horse power of work performed. 450 pounds of coal per hour divided by 210.45 (I. H. P.) = 2.14 pounds per I. H. P. per hour. Ratio of actual work performed to I. H. P. of the engine, 59 per cent.

As a conclusion to these remarks, we will venture the opinion that from various features, some of which have been pointed out, the original cost of these works is not more than one half as much as is commonly expended to attain a like duty, and this without the sacrifice of anything involving durability of the machinery or economy of working; also that in the plants recently constructed on this Coast, the efficiency is as much if not more than has been attained any where.

SYSTEMS OF PIECE WORK.

No. 1.

In No. 1 of this Journal, issued in August, 1888, will be found an article under the above head, and some tables of estimate or contract work in machine shops at Manchester, England, which we propose to reproduce in connection with the present article.

The subject of contract work since then has come up spasmodically, indicated by inquiries and requests for copies of the Journal before mentioned, but, so far as we know, no one in this country has attempted a system that can be called the same, or founded on the same principle. Instead, however, we have had endless essays on "profit sharing," and various other paternal methods analogous in nature if not in name, none of which have comprehended the main principle of all, that of placing workmen in a responsible position and holding them responsible.

All systems that in any way concern workmen in profits, or the commercial conduct of a business, are more or less paternal and consequently degrading, not directly but indirectly. It is placing the skill, one of the most important elements in production, in a dependent position, with earnings contingent on some other person's judgment, and not upon the work itself. Such a system involves accounting, which is in the hands of employers alone, and creates suspicion, often warranted, as to the correctness of the accounts.

In the first place, it will be pertinent to ask, what has a workman to do with the investment, conduct or policy of a business? He cannot modify these things, or deal with them, and does not need to do so. His part is the work, with this he deals, and for this he should be responsible. His manhood and independence calls for such a division, but how far from this is our present system?

A number of men are hired at a price for their "time," a driver is placed over them as a kind of spy, with powers of discharging them or otherwise inflicting penalties the same as in the case of slaves. The only incentive to do good and faithful work is such manhood as can exist under the paternal system, and that is not much, because it is only a modification of the relations that exist between master and slave, and the fear of being discharged. An owner may, and commonly does, know less of a business than his staff and workmen. He depends on these men because of their wages, and they depend on his generosity, caprice or conscience for the wages,

because the wages are an indefinite fund not dependent or contingent upon the amount and character of the work done.

This puts employed workmen in a false and menial position. They are responsible only for "time." If they do much or little it does not matter, the wages are the same. If they spoil or break material or tools, it is the employer's loss. There is no responsibility except for "time." No man in such a relation, unless he be a saint, is likely to put forth his best efforts, or feel the spur of his manhood, as he would if he were a co-worker performing his own part, and being responsible for it.

This is vigorous denunciation of the time system, and it is called for. If the alternative, contract work, was a mere "idea" there would be no reason for urging it in so forcible a manner, but it is not an experiment, on the contrary is a fact, and one of extensive application in wide districts, as will be pointed out further on.

Two essentials to the contract system are, regular profits and a knowledge of the cost of doing work. Such a system can never be successfully introduced where work is not made at some regular scale of profit, because the profit must be assumed in estimates, and not taken from the labor element. For example, suppose a stamp mill is to be constructed in San Francisco, and estimates are to be made out. These include material, labor, expense and profit, separate and distinct quantities. The estimate for labor, like the other elements, has to be made up in any case, and the contract system consists in turning this part over to the workmen at the estimate. This is their part. They are responsible, and if the owner fails with his material, expense, or profit estimates, the "shop" will bring out their part all right, indeed have to do so when a job is put in under accepted rules.

These rules are the main impediment to contract work here, for, strange as it may seem, there is little or no suitable data respecting the cost of doing work, except by comparisons or particular antecedents, and, we may add, almost an equal lack of all data respecting the capacity of machine tools. Such information is not very hard to procure if once set about, and when a contract system is once started prices for the work soon become a matter of common knowledge among both owners and workmen.

To illustrate what is meant we will quote the prices paid in the Manchester district, England, ten years ago, and, as before explained, published in No. 1 of this Journal, in 1888.

ESTIMATE RATES FOR MACHINE WORK.

Price in Cents per Foot for Finishing Shafts to Gauge Size. Length in Inches.

Diameter in Inches.	6	12	18	24	30	36	42
1	4½c.	4¼c.	4c.	4c.	3½c.	3¼c.	3c.
2	9½	8	7½	7¼	7¼	6¾	6
3	12	11½	11	10½	9¾	9¾	9
4	15	14½	14¼	13½	13¼	12¾	12

Price in Cents per Foot of Length for Cutting Lead Screws for Engine Lathes.

Diameter of Screws in Inches.....	1¾	2	2¼	2½	2¾	3	3¼	3½	3¾
Price in Cents per Foot of Length..	28	30	30	30	34	38	42	46	50

PRICE OF TURNING CAST-IRON PULLEYS.

For pulleys from 6 inches to 10 inches diameter, two lathes being furnished, \$1.68 for each 100 inches of surface. When pulleys have wide faces, exceeding one half their diameter, 10 per cent. additional is allowed. Convex and flat faces are the same, the lathes having angular feed in the tool slides, the work is the same in each case.

BORING PULLEYS TO GAUGE SIZE.

Price in Cents for each Pulley.

Diam. of Holes in Inches	1½	1¾	2	2¼	2½	3	3¼	3½	3¾	4¼
Price for Small Pulleys..	2	7	8½	12	17
Wide Face Pulleys	24	24	24	24	31	38	41	44	58	62

PLANING LATHE FRAMES.

Per Superficial Foot of Planed Surface.

10 feet and less, 32c.; 10 feet to 20 feet, 30c.; 20 feet to 40 feet, 26c.; 40 feet to 60 feet, 24c.; 60 feet to 80 feet, 20c.; 80 feet to 100 feet, 16c.

SPECIAL PLANING ON MACHINE-TOOL WORK.

Price in Cents for each 100 Inches of Surface.

Compound Rests	44c.	Planing-Machine Tables.....	12½c.
Head Stocks	30	Racks	14
Saddles	48	Uprights	41
Radial Drilling Machine.....	50	Crossheads.....	25
Planing Machine Beds.....	17	Tool Boxes	36

The planing for shaping machines is set down at 17 cents per 100 inches for frames and tables, 36 cents for "undercutting," and 29 cents for rams and saddles.

Surface plates are prepared at 96 cents for 100 inches. Double plates, \$1.20 per 100 inches.

Apprentice labor is estimated at a uniform rate of $\frac{5}{8}$, that is, their proportion of surplus earnings is estimated on $\frac{5}{8}$ of the prices given.

At the same time the foregoing price list for machine work was procured we had copies made from the ledger account kept for six drilling machines, made at a works in Manchester, showing the manner of making the apportionment of surplus arising out of this job, showing, it is true, a large amount of clerical work, but routine in nature and performed at a small expense, to some extent by computing machines.

The system is not confined to regular work, but is applicable to everything done in a machine shop, and charged or sold. When in the works of Messrs. Tangye Bros., at Birmingham, about the time the foregoing tables were made up, Mr. George Tangye, the manager, remarked, "We have 2,200 workmen here and everyone is doing piece work."

This system accounts for what seems a paradox in British skilled industry, paying about double the rate of wages that men earn on the Continent, and sending the product there in successful competition. The fact is, however, that while the "rate" of wages is higher, the "amount" of wages is really less for a given work. The men work "with a will," and accomplish a great deal more, also adopt all kinds of labor-saving expedients they can devise.

Wages in the engineering trades in England are from 20 to 40 shillings, or \$5.00 to \$10.00 a week, varying all the way between these points and in proportion to skill, as has been explained previously, but the real wages received, including the surplus, is generally a good deal more, so much indeed that the best workmen rarely leave the country in expectation of earning more pay.

In nearly all the engineering works in England, perhaps in all of any rank, this individuality of workmen is manifested in many other ways besides piece work. They have a dining and assembly room where they eat their dinners and hold meetings of all kinds to discuss subjects pertaining to their work or for amusement. Periodicals of all kinds are taken and read, exhibitions are held, "smoking concerts," and so on, the proceedings being, as is the custom in that country, governed by strict parliamentary rules.

The right of the owners to fair profits is not questioned, and there is none of that communistic feeling that arises out of "profit

sharing" methods, and none of the paternalism, which of all things is most offensive to skilled men. They want no favors or concessions of any kind not justly their due by either custom or stipulation.

This system of working is almost unknown to those who go out from this or other countries to look into the British labor system. There is not even mention of it in Young's Labor Statistics, a Government document of 800 pages published about 15 years ago. It is a private matter there, never explained to strangers, and, as before remarked, has been one of the main forces in developing the engineering trades of the country.

In the next number we will consider the practicability of the contract system for machine work in this country.

(To be Continued.)

ON THE TRANSMISSION OF POWER.

With an Analysis of Compound Air Compressors.

BY A. E. CHODZKO, M. E.

GENERAL REMARKS ON THE TRANSMISSION OF POWER.

The transmission of power ranks amongst the most important subjects which have, during the past thirty years, engaged the attention of the engineering profession. This problem, in whatever particular form it occurs, can always be reduced to the following general terms:

To convey and distribute a certain amount of power, which can be more conveniently generated at some distance from the points where it is to be used, than it would in their immediate vicinity.

This class of questions is a direct outcome of the fact, which needs here no demonstration, that a large aggregate power, if generated at a great many different points, and in small amounts at each one of them, is more expensive to produce than if the whole was generated in a single motor. Such is the origin of the central power station, and the problem is: how to convey power therefrom, either to a number of different places, or to one other single place. Any practical answer to this question constitutes a system of power transmission.

A system of power transmission is essentially formed of four distinct elements :

1. A generator of power, situated at a central station.
2. An active medium, wherein this power is concentrated, and whose object is to transfer it to its destination.
3. A conductor, or passive conveyor of this medium.
4. Motive apparatus to utilize the conveyed energy.

It is not the intention to enter into a detailed study of the various systems of power transmission ; both the quantity and the nature of the problems involved in such a work exceed the scope of the present paper, and only an outline of the subject will be offered.

Six principal mediums of power transmission are known at present, whenever the distance between the generator and receptors exceeds the limits of a factory. These are : (1) traction by wire rope ; (2) water under pressure ; (3) steam ; (4) gas ; (5) electric current ; (6) compressed air.

The generation of power is effected, either by steam or by a fall of water ; in gas transmissions, heat is also a primary agent. But if one considers the co-relation between the velocity of motion in these various mediums, over conductors, and the size of these conductors, a distinctive line may be drawn between the rope system and the five others, namely, in the former, the velocity with which the active medium is carried over a conductor does not in any way affect intrinsic energy. In other words, a pull, or tractive effort of 100 pounds, exerted at the generator end of a teledynamic transmission, would be integrally conveyed by the rope to the receptor end, whatever be the length and the size of this rope, and also the rapidity of conveyance, if there were no intermediate sheaves between the two ends of the rope. The resistances due to the friction of sheaves, or to the flexure of the rope, would be concentrated at the terminal sheaves, but not generated at the conductor.

The result is that a high efficiency is not only consistent with high velocity and a small conductor, but within the limits of safety and of resistance, such are the very conditions of high efficiency in a teledynamic transmission, because a high velocity of motion means a small tractive effort for a given power, and consequently diminished friction of the sheaves in their bearings, and a reduced size of a rope proportionally reduces stiffness or resistance to bending.

Some remarkable applications of this system have been in successful operation for a number of years past. More recent and no

less important illustrations are found in the cable roads, and in the various systems of aerial ropeways for transporting ore and the like.

Taking now the five other mediums for transmitting power, one finds water, steam, gas, and compressed air. The energy of these mediums obtainable at the points of application, compared with energy at the generator end, is directly affected by the size of the conductors and the rapidity of motion of the active medium, and the resistance occurs on the whole length of the conductors, increasing with their length; here a condition of high efficiency for a given power and a given size of conductor is, that the velocity of the active medium be limited to a point beyond which this efficiency falls rapidly.

The resistance to the free flow of an electric current is also greatly affected by the size of the conductor, and varies inversely with the size and proportional to the length.

The above distinction between the first system and the five others should not be construed as a criticism of the general efficiency of each system, but only as a peculiar feature inherent to the different nature of the active mediums.

Present knowledge of the subject does not permit us to formulate limitations of distance to which power can be transmitted. We are no doubt on the eve of important developments in this respect, and the results of the contract between the Niagara Cataract Company and the State of New York, for a 300 mile electrical transmission, will be eagerly watched by the engineering world. What the future has in store from the discoveries of Nikola Tesla and others, is now a matter of speculation.

So long as the distance is not great between a generator and the receptor, any one of the above systems may be applied. No absolute rule could be given, suitable to all cases, as a guide in the selection between them, because no such rule exists; the distance of transmission is but one of many conditions to be considered. There are cases in which water has an uncontested superiority over any elastic and compressible power medium. The following statements are therefore applicable to the general problem of power transmission, and remain open to possible exceptions.

When the distance is three or four miles, the choice between the systems of power conveyance is narrowing down, and when power is to be transmitted ten or twenty miles, electricity and compressed air appear to be the most advantageous. One class of applications exist, which have been the subject of exhaustive experiments, and

have furnished some highly valuable and positive data, the distribution of power over a concentrated field, as in cities.

In this case the central station and each receptor are not connected in the most direct way, but a main conductor is spread out into branches involving numerous changes in the direction of the course or flow. These circumstances render rope transmission impracticable. Water is also unsuited on account of the loss of pressure and contraction of the passages. The danger of frost is also an impediment in most places. The choice is therefore between steam, gas, electricity and compressed air.

Changes of temperature have much influence upon the energy of steam, whilst gas, electricity and compressed air are unaffected by temperature. But aside from this fact, which is a serious objection to steam transmission, all fluids under tension confined within conductors are liable to escape and waste, causing a direct loss. In the case of steam such loss occurs by leaks and heat radiation. With gas, by leaks only. With electricity, all over the conductor if a contact occurs with some other body. With compressed air, by leaks only.

Complete insulation of the conductor is required in electrical transmissions; with air and gas the joints alone have to be guarded. Steam requires both close joints and insulation or covering to prevent radiation.

The effects of leakage, besides the loss of energy, involves personal danger, damage to surroundings and property by heat and moisture; eventual danger of fire. With gas there is danger of personal injury, danger of fire and of explosion. With electricity, danger of personal injury, serious danger of fire if contact exists between conductors and their surroundings; with compressed air, no bodily injury, no danger of fire. The preheater used in connection with the receptor is a small apparatus under easy control, because it is in operation during working time only. In this respect compressed air is distinctly superior to other mediums of transmission.

Investigating next what becomes of the transmitting medium after it has performed its work, one finds: Steam has to be condensed or conducted into the atmosphere clear of all surroundings. Gas is deleterious, and must also be conducted clear of surroundings. Electricity has no objectionable effects so long as insulation is effective. Compressed air produces beneficial effects by a supply of fresh air in the premises, and by utilization for various purposes.

One feature wherein compressed air stands above all other means of power conveyance is in the possibility, when employing proper apparatus, of obtaining a practically perfect working efficiency. The result is mainly due to the fact that it is possible to introduce additional energy before using the air in a motor or engine, and this is done with no objection or expense worth considering. Compressed air therefore presents more elements of economy, safety and convenience than any other medium of power conveyance in a city or circumscribed district. From the consumer's standpoint its advantages are even greater than from the engineer's.

Experience has shown that an air motor will start instantly after any length of stoppage, which is seldom the case with a steam engine, and still less with a gas engine. The absence of the noise and offensive odors is a great advantage, also the saving of space, and the reduction of insurance rates, makes an air motor a typical one for small industries, especially for work carried on in workmen's houses or in small workshops. The origin of fires in industrial buildings is commonly traced to a boiler room in the basement.

In addition to transmitting power, the exhausted air can either remain at the outside temperature, and ventilate a room or shop where the work is done; or in the cold season the fresh air, by adjustment of the point of cut-off, can escape at any warmer temperature desired.

On the other hand, as pointed out by Prof. A. W. B. Kennedy, is the case of a Paris restaurant where compressed air, after actuating an electric light plant, was exhausted through a brick flue into the beer cellar; in this flue the carafes were set to freeze, and large moulds of block ice were made for table use, while the air was still cold enough in passing away through the beer cellar to render the use of ice for cooling quite unnecessary, even in the hottest weather.

The advantages of this mode of power transmission, it is strange to say, are little known, and erroneous ideas prevail about the efficiency of air as a motive medium.

AIR COMPRESSORS.

Up to a comparatively recent date, applications of compressed air were confined to mining and tunnel works, mainly in rock drilling, and less frequently in driving underground hoisting, haulage or ventilating plants. As a rule all the machinery constituting the motive machines employed was of the crudest and most uneconomical description.

In both rock drills and underground engines the air was used with little or no expansion, and allowed to escape at a high pressure. In the course of his investigations on the subject of power transmission, Prof. Riedler quotes the efficiency of small mining plants as reaching only 10 to 15 per cent. of the power applied to the compressors. Even in large tunnel works, where high-class single-stage compressors were used, the proportions of 22 to 32 per cent. were for a long time considered as the best efficiency obtainable in practice, according to whether the air pressure was high or low, and the logical conclusion of this was that low air pressure was an element of high efficiency.

The heating of the air prior to its use in engines, permitting complete expansion, led to a high initial pressure, since a given amount of work became available from a small volume of air. Such high pressure permitted smaller mains for conveying the air from the compressors to the motor, another cause of economy in first cost of air-transmission plants, but this economy could not have been maintained through the whole system with single-stage compressors, or when compression is performed in one cylinder. Experience has shown that while $p v^{1.4} = \text{constant}$, is the symbol of adiabatic compression, and $p v = \text{constant}$, the symbol of isothermal compression, the most perfect cooling arrangements used in air compressors cannot give a better result than $p v^{1.2} = \text{constant}$. A single-stage compressor with spray injection shows 0.845 as the highest attainable efficiency for seven atmospheres absolute, the efficiency of an isothermal compressor for the same terminal pressure being 1.

What preheating had done at the motor end of the transmission was effected at the generator end, although to a less degree, by the multiphase compression, *i. e.*, by compressing successively into several cylinders, and also by the use of a positive motion of the valves. This class of machines, known by the name of compound compressors, must be considered as an essential and imperative element in the compression of air. The efficiency of a triple compound compressor for the above quoted terminal air pressure would be found equal to 0.95.

It may be safely asserted that except for quite moderate pressures, or when the question of economy of power is clearly superseded by considerations of first cost, and the simplicity of the plant, the compound machine must be regarded, not as it often is, an object of unnecessary perfection, but as the rational type of modern compressors. This fact had been recognized by the pioneers of com-

pound compression in America, the Norwalk Iron Works, of South Norwalk, Conn., and it is creditable to them to have pointed out, at a time when this subject was but imperfectly known, that the exception should be the single and not the compound compressor.

It has been thought that a summary of the principles of compound compression would prove of interest, and this is the subject of the second part of the present paper. While the use of thermodynamical formula is unavoidable, the following developments are offered in such a form that ordinary mathematical knowledge will render their perusal easy.

(To be Continued.)

REJECTING PATENT PETITIONS.

At a late meeting of the American Institute of Electrical Engineers, in February, there was a discussion of a paper previously read before the Society, by Mr. Mauro, of Washington City. In the remarks made by Mr. W. B. Vansize, there is the following :

“ Would it not be better policy and better practice for the Patent Office to follow the very liberal doctrine declared by the Supreme Court, in pursuance of which an inventor might secure his patent rights, and this, even in cases where there existed reasonable doubt on the so-called question of ‘ invention ’ ? In this case the possible error of the Patent Office could be rectified in the Courts. If you deny a patent, you cut off all chance which the inventor might have of securing suitable protection and remuneration for his possibly meritorious invention. You condemn his invention, and you deny that you may be in error. Our papal friend in Rome cannot exceed that doctrine. In my humble opinion, if change is desirable, it would be far better to abolish all examination as to merits, and grant a patent to any applicant upon payment of the proper fees. That is the English custom, and it certainly avoids the rank injustice into which this novel policy is forcing us.”

In a communication from Mr. Almon Robinson, commenting on the same subject, there is the following :

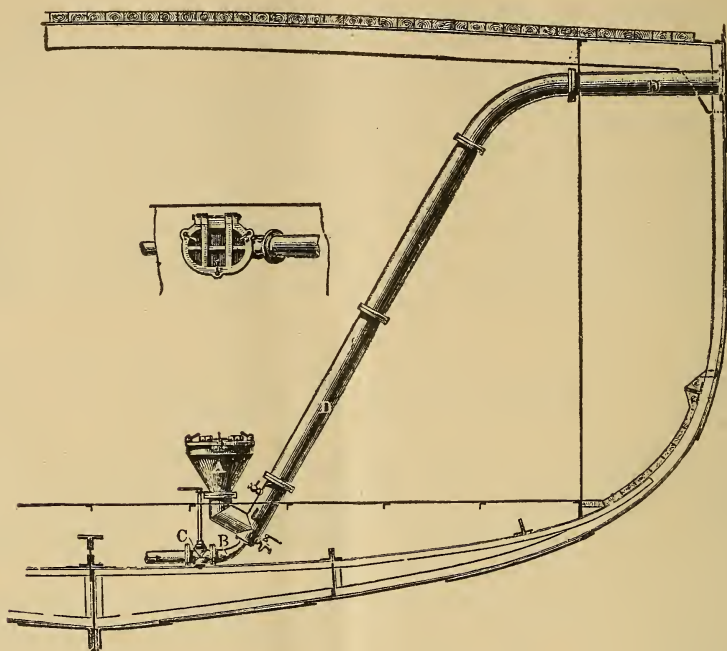
“ The real trouble, however, with the supposed plan of the Commissioner, is not that he is fighting an imaginary evil, but that the office will unavoidably work injustice in carrying out his ideas, and this will come from something that lies deeper than any personal shortcomings of the examiners ; from the fact that an examiner has loaded upon him the distinct and incompatible duties of State’s attorney and judge. He is first called upon to hunt up every possible objection to the granting of the patent, and must then sit in judgment upon his own work. It is not in human nature for him to judge fairly.

It is easier to point out the difficulty than the remedy, but I venture to suggest a modification of a plan that has been before brought forward. Let the examiner do his worst, and set forth all the objections known to him, and give the applicant the privilege of taking out a conditional patent, on which all the examiner's references and objections are endorsed, and print these with the claims in the *Gazette*. Endorse on the printed copies and publish in the *Gazette* anything further which comes to the knowledge of the examiner, so that the full state of the art as he understands it shall be at all times accessible to the public. Then provide in the Patent Office a board of appeal before which the patentee must take all matters in dispute before attempting to collect damages of infringers."

These are by no means all of the recent cases wherein the "rejection" of patents by the examiners has been discussed, and in each there is recognition of the anomalous nature of such a proceeding. A patent is a conditional grant, or a contingent one, the value of which depends on novelty, and this, as everyone knows, cannot always be determined by the examiners. It is a question of fact, not one of law, but is judicially determined by a rejection which prevents the establishment of the facts.

It may be claimed there is the right to appeal, but the result of an appeal is only the confirmation or reversal of the examiner's decision that has gone before, and partakes of the same objections, that is, the right to destroy a patent without a corresponding power of confirming it. The responsibility is in the end thrown upon the inventor, and why not in all cases, is a problem not easy of answer.

The main reason in favor of rejection is that without this obstruction there would be repeated and worthless patents. This is a debatable proposition, with the facts on the negative side. We have as many if not more conflicting patents in this country than in those countries where there is no rejection, except for informality or cause other than want of novelty. Our system is a good one in other respects, and contains this extraordinary feature, which must in the end be removed. It places the examiners in an awkward position, by compelling them to pass judicially upon questions that they have no certain means of deciding, and render decisions they have no means to support. It is imposing perfunctory duties, therefore derogatory and implying a want of skill and responsibility. An examiner who could enter his views professionally in a patent application, with the power of revision up to some stage of proceeding, would be placed in an honorable and responsible position in comparison with his present one.



THE HYDRO-PNEUMATIC ASH EJECTOR.

HORACE SEE, ENGINEER AND NAVAL CONSTRUCTOR, NEW YORK.

Mr. Horace See, the well-known naval constructor and marine engineer, has devised and applied to a large number of steamers, fifty or more at this time, an apparatus for ejecting ashes from the fire rooms by means of a sprayed current of water acting inductively, and has thereby earned the commendation not only of ship-owners, but of firemen, passengers and "all who go down to the sea in ships."

The removal of ashes by hoisting gear and buckets is the principal nuisance of steam propulsion, dreaded by the watch, and, as before remarked, all on board. When discharged through a scupper chute to windward the ashes are blown all over a ship, while the clanking of chains, noise and rattle of dumping commonly wakes everyone at the end of each night watch.

There have been a good many attempts to blow the ashes out by steam ejectors, but without much success. Steam as a medium is not dense enough, and unless a powerful and wasteful current is maintained the result is a discharge from the feed hopper instead of

the out-board pipe. With water all is different, and the application of power in this manner is perhaps less wasteful than in the case of bucket hoisting.

The diagram opposite shows a side elevation of one of Mr. See's ejectors as it is fitted in a vessel. At the bottom is a pipe leading to a pump, the delivery end terminating in an ejector nozzle inserted in the bottom of and in line with the uptake pipe. At the side or on top is a short angle with a hopper, into which the ashes are shoveled and that is all. The ashes are impelled through the pipe and discharged overboard completely saturated, so they fall into the sea without disturbance, noise or any work except shovelling into the hopper.

The wonder is that the method was not long ago adopted. Here, in California, we drive gravel, including boulders of considerable size, up pipes and inclines with water jets, and ashes, as all know, have a specific gravity so much less that the successful operation of Mr. See's invention will not be questioned here.

EXTRACTS FROM A NOTE-BOOK.

BY "TECHNO"

No. XXI.

LITTLE BELGE — THE GIANT ANTIGONUS — BRITISH FORTIFICATIONS
MONS MEG — DOG TRACTION — A CITY SET ON A HILL.

————— Having now got settled down, or rather "settled up." My experience locker replete with a new stock, and my Uncle again on shore, with a disposition to remain there, for a time at least, the old note-book has been hunted up, I find the following at the tail of it, which will be used for a start again. A letter just received from my Uncle, forebodes an expedition of some kind with myself as an integer. Of this more in future.

————— On the margin of my notes I find at this point a memorandum saying that my Uncle, who was called back to England for two or three days, left me to look at Belgium alone, and if not well done, to be taken up and all gone over again on his return. This was a strain, of course. Here is the result.

————— Belgium, because of its small limits, and being wedged in between greater countries, is but little known in proportion to its real claims as a State. Three cities, Brussels, Antwerp, and Ghent,

together contain over a half million of population, one half being in Brussels. Two million chaldrons of coal, and 160,000 tons of iron are annually produced. Cloth weaving at Verviers occupies the labor of 4,000 men. One machine-making and iron-working establishment near Liege, the Society Cockerill, employs over 10,000 men, and is the third largest in the world. The country is checkered over with railways, the system answering as a model for many countries who have tried to imitate it. All these things and many more are written down in official books, however, and we now pass to other matters.

Antwerp, where the giant Antigonus stood watch over the Scheldt and exacted toll from passing vessels, owes its name to a peculiarity of this mythical personage, who cut off the hands of those who would not pay, and threw the hands out over the walls of his den, saying "where they light let there be a city." "Werpen" in low Dutch, or "Weafen" in German, is to throw, and "Antwerp" is "hand throw," but how the French make "Anvers" out of it is not so clear. Not only in France, but in Belgium, this last is the name. Ghent becomes "Gand" in Belgium or France, and the traveller becomes confused over these, like the writer, when he was in "Achen," inquired for Aixlachapelle; worse things have been done, however.

"How would you get along without speaking German, when in Belgium?" inquired a friend in America, when a considerable company were assembled. I waited some time before answering to see if anyone would correct him, and am yet convinced that everyone present thought Belgium was a German State. There is, however, nothing German about Belgium; it was sliced off from Holland in 1830, because of incompatibility of temper and other purposes, a divorce of international policy, and is French as a country. French is the language of the educated, and in Brussels is spoken almost exclusively, except among servants, who are for the most part Flemish. The Belgians are Celtic and Teutonic in origin, and may at this day, be called French, Flemish and Walloon. The aspect of the country, the manners, customs, and nearly all which a traveller sees differs but little from Normandy in France, and only from the whole north of France in a greater prosperity. Coal, iron and England made Belgium. England in acting as a factor, was true to her trading instincts; there was an axe to grind somewhere; disinterested policy is not one of British peculiarities, and if she spends money, you may depend upon it, there is something to come out of it some way and some time.

The traveller in approaching Antwerp from the country is astonished to see two lines of fortifications of immense strength, one about 15 miles, the other, perhaps 5 miles long, encircling the city. The outer line being a chain of strong earthworks, may not be noticed, but the inner line will be sure to be seen, and is not unoften thought to be a city wall, which it is indeed. Bomb proofs, dens, magazines, guns and all the infernal machinery of war is hid away about these quiet looking grass-covered mounds, ready to be used at an hour's notice.

My vis-a-vis at table-d'hôte, was a major dressed in the neat and somewhat *outré* style of Belgian officers. I was introduced by the host, and as the officer spoke but little English, and I less French we managed to converse with difficulty, but this very fact, as is always the case, makes people communicative. They imagine what is told can not be repeated, because so imperfectly understood. One of my first questions was about the forts; "what are they for?" said I, "are the Belgians likely to attack one of their own cities? If the forts faced the Scheldt, I could see some purpose for them." The major hesitated, but finally leaned across the table and whispered very loud "Engleesh." I stopped to think, and in a few minutes and without another question, had what was then considered, and is now believed to be the meaning of this fortification of the landside of Antwerp, and I venture to here repeat the substance of my conjectures.

Belgium is the Continental out-post of Great Britain and answers the purpose which Calais once served, only in a more extended sense. Antwerp is the Continental rendezvous for stores, ships, men and war material in case of war with Germany or France. In twenty four hours an army can be moved from any part of England to Antwerp, and would at once be impreguably intrenched behind these strong earth-works. Immense warehouses stand along the water apparently idle, but all these things have a purpose. English gold has, no doubt, erected the warehouses and paid for the forts. It is all part of one plan reaching back to the time Leopold of Saxe Coburg, Queen Victoria's uncle, was placed on the Belgian throne, but there is no fault in this if all is as conjectured, and it is only one more evidence of England's sagacity and foresight, which has brought nearly ten millions of square miles under her control and given her sway over 325,000,000 people. Belgé is the gainer. No right is abridged, no restraint imposed, and she has the whole military force of Britain to avail against aggressive measures on the part of Germany or France.

Going from England to the Continent, Antwerp is one of the first cities where a stranger may see the street traffic, watched over by the Virgin. At every crossing of importance in the older parts of the city a Madonna will be seen perched up on one or the other of the four corners, often on two corners. She is commonly symmetrical and brilliant in blue and gold, but sometimes crude and imperfect. The carvings are generally about life size, and of wood.

Tapers are lighted around these images on fete days, and in some cases when the donor of the Madonna or the occupant of the house can afford it, one or more burners are kept up each night, answering the double purpose of improving the street lighting, which is bad, and calls the passers-by to a thought of the ever presence of "Him who watcheth over all." This old custom, which measured by modern standards and especially from a protestant point of view, seems ridiculous and idolatrous, is, in fact, no such thing.

The traveller who has risen at 5 o'clock on a winter morning in one of the cities of North France, Rouen, Amiens or Arras, and attended the churches to see hundreds kneeling on the cold stone floors, offering up their devotions, and then goes home to read through the morning papers, to find that twenty-four hours had elapsed without a single offense warranting an arrest by the police, will be convinced that there are more ways than one of controlling and saving people from crime and disorder.

Antwerp has many things of interest to be seen. The pictures in the museum are justly celebrated. The zoological gardens, although not so extensive as at London or Paris, have something about them which renders them more interesting than either of the latter, the selection is better or the classification and arrangement more complete, at any rate one will go to the zoological gardens at Antwerp and the next day will want to go again. At Hamburg, where there are many more animals, one trip satisfies.

Across the Scheldt, a mile distance, where a collection of wooden sheds stand on the bank, one can see the word "Gand" written up in giant letters; this is the terminus of the railway connecting Antwerp with Ghent.

Crossing on the ferry, and enduring a tedious ride of two and a half hours through the *Pays de Waes*, costing about one dollar, without anything of interest to see, will land a traveller in Ghent. Here there is a population of over 100,000; good hotels, good buildings and in some respects a resemblance to Brussels. Houses, which coming from England one would take to be the residence of a

royal duke, turn out to be occupied as baker shops, barber shops, groceries and the like.

What is the reason that in England a peculiar plan of buildings was invented which we in America follow out, and why is it that in France, Germany, Sweden, or as we may say, in nearly the whole of Europe, houses are arranged about courts, and people live on "flats" as we call it? I suppose there are good reasons for both plans. The query is, how is it that the two plans exist?

Here in Ghent, a given area of ground and a given expenditure in building, will house and accommodate twice the number of people that a like space and investment would in London or old New York. Everyone enjoys the satisfaction of living in a good house, which can be warmed at half the expense and no stairs to climb. The privacy is just the same as in detached houses. I have lived both ways and prefer flats in a Continental house. The Scotch in both Edinburg and Glasgow build on the *etage* method, and the system may at some future time, say a hundred years from now, reach London. It will require about this length of time to introduce and harmonize a change of the kind in conservative England.

————— Every one, at least every one in England or America has heard of or seen the celebrated "Mons Meg," that wonderful old wrought iron gun mounted at Edinburg Castle. A gun of 20 inches bore, built of staves and then covered with rings of wrought iron, a piece of work that would puzzle many of our modern gun makers to perform. This gun, supposed to have been constructed in Mons, Belgium, some centuries ago, stands as a proof how invention repeats itself. I had sat beside "Mons Meg" many a time ruminating. It was my pet antiquity, nothing seen abroad had the same interest, judge then of my surprise, not to say disgust, when in turning a corner in Ghent I found myself face to face or, more correctly speaking, face to muzzle with another "Mons Meg," an exact mate to its Edinburg sister, having so near as I could determine the same dimensions every way, only the present one is not fractured as the Scotch one is. This old relic which tells no mean story of the skill and ingenuity of the Belgians at a period which is a remote one, in the mechanic arts, stands in front of a kind of market-place on a substantial frame. A glance in its cavernous depth showed a lot of children's playthings in the gloom at the bottom, a noble use of it. "The wolf shall lie down with the lamb."

We have sacred authority for assuming that "a city set on a hill cannot be hid," and certainly if the proposition is granted,

Brussels is not likely to disappear from vision. Perhaps no city in the world can with equal propriety, be described as "set on a hill." There are many cities on higher ground, even on mountain tops, but this is not what is meant. Brussels includes the hill, not only stands on, but surrounds a hill, and one of the steepest in the world to have streets running up and down its sides. This claim is made, with a full remembrance of English Sheffield, and half a dozen undignified attempts to sit down and slide, dating from my first trip down High Street in the city last named. The practicability of climbing the street in Brussels, like many other human achievements, is a result of practice. A horse taken to Brussels from some level city could no more climb one of those streets leading up to the palace and park, than he could ascend a fireman's ladder. It is learned by experience, and well learned too, for omnibuses filled with people are drawn up by three horses. Brussels is one of the most beautiful cities in Europe, and on the same assumption, in the world. This is stating it strongly, but is no more than giving an opinion which exists elsewhere than in Belgium. With one fifth of the population Brussels rivals Paris in what may be termed attractiveness. The wealth of cities is as their extent, that is, the means to beautify and improve is as the value of the ground, and this increases very regularly with the extent of the population. Ground has been sold in London at the rate of five millions of dollars for an acre, and in certain parts of Paris is no doubt worth five to ten times as much as the most valuable sites in Brussels. The beauty of Brussels is due to its romantic situation, the taste of a highly cultivated people, and to the great individual wealth of the citizens. Engineering science developed by vast manufacturing and mining interests, and the great railway system, has among the Belgians attained a foremost place, and on this science modified or controlled by a refined taste, depends the development of a city so far as those features which render it attractive and beautiful. The genius of Hausman aided by the highest engineering skill, made modern Paris. The same causes are transforming London, bringing order out of chaos.

The Metropolitan Under Ground Railway is one of those creations which owes its existence to exact science, an undertaking which appalls one whose knowledge of such things allows them to conceive of what was to be combated and overcome in constructing such a line. The railway system of Belgium was developed in the same manner ; almost every line, station or switch, is a part of one

vast and perfect plan laid down at the beginning, and from which no important changes were made, because of the high skill and scientific knowledge brought to bear in preparing the original scheme.

— To come down from railways to carts, and from science to an obscure branch of social economy, I wish to record the fact that the Belgians know how to manage dogs. These favored animals, which are little more than an expensive nuisance in most countries, are in Brussels raised to the rank of co-laborers with mankind, and earn their own bread, and judging from the expression on their faces and from their conduct in general, I have not the least hesitation in asserting that a happier and better contented set of dogs do not exist. In Brussels street tradesmen and costermongers invariably have a dog to assist them in pulling their carts, and the arrangement, aside from economic consideration, is a very perfect one. The dogs do not go in front but are directly under the cart, safe from danger in the crowded traffic and take up no room. The cart can be as readily handled and will turn around in a space just as short as though the dog was not there. At the rear are a pair of legs, which rest on the ground when the cart stops, after the manner of a wheel-barrow; these legs are connected by a cross-stretcher, to which the dog is hitched with leather traces, which are long enough to allow him to walk directly under the axle. It is astonishing to see how they will manage when a heavy pull is to be performed. One may sum up all qualities of the equine tribe, that indicate reasoning power, and the whole will not be worth a comparison with these dogs. I have watched them for hours, climbed the hill alongside a cart to watch the dog and note his evident reasoning about the operation in which he was engaged. If he notices anything wrong, such as an obstruction before a wheel, he gives a bark to warn his master. When the cart stops, if tired, he instantly sets down or lies down to rest. If you go near the cart when his master is absent, the dog looks out to see what you want; if anything is touched a growl warns you, or a loud bark recalls the tradesman.

Bread, vegetables, milk, butcher meat, and so on, are served by these dog carts, and their number is legion. They correspond to the London costermongers and small tradesmen's carts, except that a dog instead of a donkey is the propelling power. Dogs churn, pump water, and assist in many things besides pulling carts, and to a person who does not like dogs, it is a relief to visit Belgium

and see that it is not their fault if dogs are worthless, and that if men are foolish enough to give a share of their labor to support dogs, and will not even invite them to assist, no fault can be found. Miss McFlimsy's poodle, which in actual outlay for provisions and attention costs \$100 a year, one fourth of what some poor men earn at hard labor. Many a poor man where children are half clothed and denied the comforts of life, divides his earnings with several worthless curs, who never earn a cent, and not unoften destroy much besides their food. They manage these things better in Belgium.

————— Brussels is not all set on a hill, as might be inferred from what has been said in a former place, the newer and we may say the main part, is spread out over a plain. Cities built on hills have all been sadly metamorphosed by the modern railway system. Locomotives do not climb hills, and the result is that cities set on hills must come down to the locomotive. There are not a few cities that have been much changed from this cause, and Brussels is among the number. Business naturally gathers about the terminal or station of railways, and the accretion of population and buildings which follow upon the construction of a railway soon shifts the center of a city and gives rise to new interests, which change the complexion of everything.

(To be continued.)

————— Gas engines continue to grow. We note in the circulars of Messrs. Tangye Bros., of Birmingham, England, that they are making regularly engines of 40 "nominal horse power," which must mean 80 to 100 indicated horse power. This growth is slow, and so much the better. There are problems in large engines that do not apply in small ones, but it is safe to assume that in so far as the expansion of the gas by combustion, will give a better "card" with a large than a small engine. The development, as a whole, from 1875 has not been too slow. But little has been lost by blunders or worthless engines, and fortunately the improvements, most of them, have been in details that could be added to old engines. Conjectures as to the future of internal-combustion engines are many and wild, but it is not too much to admit that if progress goes on as it has for ten years past, motive power will be divided into steam and gas engines, with the greater possibilities on the side of the gas.

THE SAN ANDRES ROPEWAY, DURANGO, MEXICO.

Mr. Graham, the manager of the Vulcan Iron Works, in this City, has brought to our notice the great ropeway recently erected by that company for the San Andres de la Sierra Mining Company, in the mountains of Durango, Mexico. Mr. McIntyre, the telpher engineer of the Vulcan Iron Works, has been more than a year planning, surveying for and erecting this great ropeway, which is not only the longest of which we have any knowledge, but was constructed with a boldness, and in the face of physical difficulties, unsurpassed in engineering work of the kind.

The distance between terminals is 16,712 feet, or 3.16 miles, the length of the cable, which is in one piece, being double this, 33,424 feet or 6.32 miles. The terminals are at an elevation of 2,875 and 7,200 feet, respectively, so the descent or ascent is 4.325 feet or nearly one mile of altitude. There are 45 intermediate supporting structures and 171 cradles or conveyors on the line, employed mainly for charcoal and wood used at the smelting works of the San Andres Company. The charcoal is conveyed in bags weighing from 100 to 125 pounds each. Wood is conveyed in bundles, soaring in mid-air over chasms 150 to 200 feet deep and between spans from 1,000 to 1,600 feet.

The cable left the Vulcan Iron Works in this City in September of last year in twelve pieces that had to be joined on the ground at San Andres, the splicing being a difficult work, calling for great care and skill. The transportation was tedious, requiring until January 2, 1894, for the first section to reach the mines, the most difficult part being from the coast inward 150 miles through the mountains. The cables were loaded on a train of 132 pack-mules, making a caravan nearly three fourths of a mile long, each piece of cable requiring twelve mules. In this manner, over dangerous passes, the train made its way without accident. Numerous expedients were adopted to secure safety and concert of action in the trains, which we have not space to describe.

The Vulcan Iron Works make a specialty of these ropeways, on which there are a number of patented features, and in some cases have produced a saving that paid for the whole work in a few months. In one case reported, also in Mexico, the saving over pack-mule carriage was \$33,500 in one year, by a ropeway that cost \$19,400. Mr. Graham, manager of the Vulcan Iron Works, handed us a

letter from Mr. Antonio H. Paredes, managing director of the San Andres Company in Durango, attesting the complete success of the undertaking, Mr. Graham remarking at the same time that much was due to intelligent management and co-operation of Signor Paredes. The economic results are not yet tabulated, but will be enormous. The furnaces consume 110 "cargoes" of charcoal each day costing formerly \$236.50. Now the cost is less than one half as much, \$110.00 a day or a saving of \$30,000 to \$40,000 a year, on charcoal alone, but this is not all. The supply was contingent upon various circumstances and uncertain. Now it can be depended upon. The works were closed a third or more of the time, by reason of storms, want of feed, and various other circumstances such as befall animal carriage, so the real saving effected by the ropeway is much more than the sum named, perhaps twice as much.

The Vulcan Iron Works have sent profiles and other technical data, which we have not space to include, the main thing, however, is the result attained by the ropeway system, indicated by the facts above given.

WOOD PLANING.

We have on many occasions argued that American planing and moulding machines are made wrong end foremost, and have endeavored to bring out some views and reasons for what seems to many people a "paradox." Mr. Joseph Long, in a courteous essay on this subject in the *Wood-Worker*, has adduced such reasons as are possible for the American method, but they do not meet the case at all, and would never do to present before a purchaser in Europe who wanted American machines for wood-working. We maintained for many years the largest stock of American wood-working machines kept at one place in Europe, and for a time endeavored to defend the American system of planing there, but it is impossible, technically, logically or mechanically. We were amused at Mr. Long's comparison of the interest here, being a giant compared to that of Europe, where about 500,000,000 of people use wood-work much the same as we do in house finishing, furniture and other purposes, but less for framing in buildings. There are wood-working mills in Norway, much larger than any in the United States. We will return to the subject soon.

THE TECHNICAL SOCIETY OF THE PACIFIC COAST.

This Association met on the 6th of April, the stated meeting for the month. Dr. Frederick Solathé presented and read a paper entitled "The Origin of Petroleum."

No better synopsis of this paper can be given than to quote in part its introductory section, that is, the scope and purpose of the essay is here indicated with certain interesting facts concerning the opinions of learned people who have given study to the subject. The following is the excerpt selected :

"The various views on the origin of petroleum can be classified into two distinct groups.

First.—The hypothesis of inorganic origin, or the so-called "emanation hypothesis."

Second.—The hypothesis of organic origin of petroleum.

This latter is divided into three distinct theories, namely :

(a)—Hypothesis of animal origin.

(b)—Hypothesis of vegetable origin.

(c)—Hypothesis of animal and vegetable origin.

First.—The hypothesis of inorganic origin of petroleum ; Alexander von Humboldt, in 1804, already favored this theory. He says : " There is no doubt that petroleum is the product of distillation taking place at immense depths, and is produced from primary formations, below which is the seat of all volcanic action."

Byasson obtained petroleum-like products by acting steam, sulphureted hydrogen and carbonic acid, on iron at red heat. He draws the conclusion that sea water, carrying marine lime by infiltration to great depths, reacted upon iron or iron sulphides at white heat.

In 1878 Mendelejff published a carefully prepared hypothesis of the inorganic origin of petroleum. This chemist explains the formation of petrol by the penetration of water through terrestrial fissures to the supposed pyrogenous zones of the earth, which he regards as consisting of meteoric-like carbonaceous iron. He bases the presence of unoxidized metals in the interior of the earth upon the existence of metal, iron and carbon formed by spectroscopical investigations in all celestial bodies.

The average density of the earth being 5.5, points to the above stated assertion. The average density of rock formation is about 3,

therefore the presumption that the interior part of the earth has a density of 7 to 8, nearly the specific gravity of iron, is well founded.

Iron, another metal, produces oxides from the oxygen of water, while hydrogen is liberated partly as such, and partly in combination with carbon, in the form of hydro-carbons, a volatile substance, petroleum.

These hydro-carbons ascending into higher regions are condensed and absorbed by suitable strata of sufficient porosity. This re-action can only result through complete contact of these agents in question, that is, carbonaceous metals at white heat and water in form of steam.

If we examine these conditions closely we must assume the following zones below the earth's crust: 1st, a liquid carbonaceous metal or iron zone; 2nd, the slags, which nearest to the metal are in a perfect fluid state, then becoming semi-liquid until plastic, and only above we find the solidified earth crust.

These fissures and crevasses can only extend to a depth where the material is solid and fragile; while on the soft, plastic or liquid material their existence is of course entirely out of question.

We naturally must draw the conclusion, owing to the protective coating of these stage zones, that a penetration of water, and here-with a contact between water and metal is excluded.

Several experiments made later on by the same chemist, for instance, the reaction of sulphuric acid on carbureted manganiferous cast iron yielded liquids, which by their odor, color and re-action closely resembled crude petroleum.

Other hypotheses, in close relation to the above, originated by Rozet, Prott and Thoré, consider eruptive masses as genetic cause or accompanying the presence of petroleum.

Ross favors an organic origin of petroleum, for the reason that paraffine is absent in fish oils, that petroleum is in most instances accompanied by limestone, and traces of a past volcanic action can be discovered."

A discussion of some length was held in respect to a proposed technical congress to be held in this City in June of the present year, under the auspices of the Technical Society of the Pacific Coast, at which would be presented and discussed papers on the scientific, industrial and economic interests of this State. The proposition being favorably received a resolution was passed requesting the President to appoint a committee of two members to act in con-

junction with himself and the Secretary of the Society to consider the expediency and practicability of holding such a congress. Messrs. G. W. Dickie and John Richards were appointed as such a committee. They will present a report about the 1st of May, or a little later.

THE IRRIGATION MOVEMENT.

[Communicated.]

Active preparations are now being made for the next National Irrigation Congress, to be held about September 15th, at some point in the West, not yet determined on. The last Congress, which was in session an entire week in Los Angeles, October 1893, appointed commissioners in every Western State and Territory, whose duty it is to prepare a report to be submitted to the coming Congress, covering all the features of special interest in each State and Territory of the Arid West. These reports will show the amount of arid and semi-arid land; the amount of land now irrigated, and the acreage believed to be irrigable; the sources of water supply, developed and possible of development; the cost of procuring, storing, and delivering water on lands; State legislation, in force and needed; National legislation as to the disposition of arid lands and Government control of water sources; and such other points as may suggest themselves to each commission as being pertinent to their own State.

The Commission for California is composed of Messrs. Eli H. Murray, San Diego, chairman; C. C. Wright, Modesto; Will S. Green, Colusa; John A. Pirtle, Los Angeles; L. M. Holt, Los Angeles; Frank Robbins, San Diego, secretary.

The citizens of California are cordially invited to correspond with any of these gentlemen, and give them such information as they may possess on the points to be covered by their report, as it is designed to cover every point of interest which can be suggested. Information covering the work of the National Committee can be obtained from Fred. L. Alles, secretary, Los Angeles, California, and information as to the work in this State from any of the commissioners named above.

LITERATURE.

The Technology Quarterly.

This among the technical serials is one of the heaviest, so to speak. That is, the themes selected are commonly difficult, and their treatment exhaustive. The publication is in fact a bulletin of the Massachusetts Institute of Technology, of which Mr. Francis A. Walker is president, and Clement W. Andrews, secretary. The college ranks among others of its class, as the Johns Hopkins University among institutions of its kind in this country, and deservedly if one is to judge by the published work of the students.

The chemical and electrical departments are as usual well represented in the present number. Prof. Walker, the president, replies to a recent article of Prof. Shaler, in the *Atlantic Monthly*, involving the old argument of academical and scientific studies, or as the title reads, "The Technical School and the University," which is hardly grammatical, because the terms are intended to be general and therefore plural.

Professor Walker has an easy task in showing that scientific studies can be pursued independently of an academic course. Conversion to that opinion, or rather the value that public opinion in this and other countries has fixed upon scientific education, will, if it go on twenty years more, constitute the classics as the "tail of the dog."

There is little knowledge of practical value in the world that cannot be mathematically expressed, and no exact knowledge of any other kind. The rest is desirable, and important in what may be called an "education," imperative we might even say, but it is easy, and a matter of memory rather than inductive and deductive powers of the mind.

Nicaragua.

ISSUED BY THE BUREAU OF THE AMERICAN REPUBLICS.
Bulletin No. 51.

This book of 177 pages, $6 \times 8\frac{1}{2}$ inches, is devoted to Nicaragua, and is in the very complete style of other publications by the Bureau. It contains a fine map of the country, with statistical, geographic and topo-

graphic descriptions of great interest at this time, also an article on the proposed inter-oceanic canal, with a panoramic view finely executed. There is also a commercial directory, a list of customs, taxes and copies of important State papers, including a digest of the laws relating to mines, with much other information too extensive to mention.

There are ten fine photo-plates produced by some process that one regrets is not more common in other literature, being in strange contrast to the usual blurs met with. Whatever other good the Bureau has done its publications must have added much to our knowledge of the South and Central American Republics. Bound as library volumes, for which purpose the books are well adapted, they form an invaluable reference as well as interesting matter for general reading.

The Art of Copper-Smithing.

It is a long time since we had the pleasure of looking over a book like the present one. It is unique, and as interesting as a romance; written by a practical man, and relating to an art familiar by constant association, but as the author says, "one wholly without literature of any kind."

John Fuller, Sr., the author, whose portrait is given, is a typical solid British workman, who dates his preface from Seneca, Kansas. His work, however, is drawn from his experience in England, through the copper-smith and brazier's arts in all of their branches, and among all the arts the one that embraces, perhaps, the largest amount of special knowledge and manual skill.

A copper tea kettle with its symmetrical handle, curved spout and planished exterior is we fear accepted in a common way as a moulded or machine product, but if we stop to consider that the vessel, with all of its complementary parts, was at the beginning a flat sheet of metal, to be cut, hammered, stretched, bent and worked into all these curious forms with "hammers," the intricacy of the art can be imagined.

A man of judgment, skilled in the general art of working metals, can do a little of

most anything when required, except copper-smithing and straightening saws. At these he can do nothing. One art does not lead up to or indicate another. Each is independent, so to speak, a matter of judgment and skill, empirically learned. An art wherein machine processes have made little or no advance and probably never will.

When in Paris in 1870 we went to examine some power-planishing machines employed in the great works of Cail & Co., where large vessels, such as vacuum pans, were being made of copper. It was thought wonderful that any process in copper-smithing could be done by machines, but the mystery disappeared when we saw the operation. They had simply substituted machine for hand power for hammering. The work was moved by hand, each blow watched, and nothing was added but the power to operate the hammers, and this applicable only to certain parts of the work.

In the present work the whole art is presented as far as is possible. Vessels from one gill to 36,000 gallons are shown in the drawings, of which there are between four and five hundred. Complicated forms of pipe work, and indeed all that can be expressed in rules and diagrams, is dealt with in a clear manner, written in an exceptionally pure style and complete clearness.

The work is $6\frac{1}{2} \times 10$ inches, contains 130 pages, and is sold for \$3.00 by the publisher, David Williams, 96 Reade St, New York.

Twenty Years with the Indicator.

Messrs. John Wiley & Sons, of New York, have issued a new edition of Pray's *Twenty Years with the Indicator*, of which more than 10,000 copies have been sold, a fact that may well substitute any opinions of the editor in respect to the work.

A first impression to almost any one will be that there is no need of an octavo volume of 300 pages to explain the use of steam-engine indicators, and there is not, which brings us to saying that the present work is in fact a treatise on steam economy, if not on steam engineering.

An indicator in the abstract is not an important matter, but in the concrete and leading up to facts, problems and conclusions in the use of steam, it comprehends the whole art except construction, and may even qualify that to some extent. This latter propo-

sition is comprehended in Mr. Pray's book, which is by far the most extensive and complete of its class.

Perhaps the best description that can be given of the scheme will be to say it is experience of all kinds, collated and put into a book; and is arranged in lessons for steam engineers, elementary, fundamental, advanced and diversified, to embrace all that can exist or happen in the use of steam.

The book is sold at the low price of \$2.50 by Messrs. Osborn & Alexander, of this City, and should be in the hands of all steam engineers who understand or want to understand their business.

Westinghouse Catalogues.

We have received from Mr. E. H. Heinrich, of the Westinghouse Electric and Manufacturing Company, a "set," or as we may say, a small library, of printed matter illustrating and describing therein various manufactures produced by the company. There are altogether ten sections, written and printed with the exceptionally good taste and excellence that has always been a characteristic of the Westinghouse literature.

Particular criticism or even an opinion respecting the advances in electrical construction here set forth, belongs to those skilled in this intricate art, a field we make no pretence to enter upon, but there is certainly a harmony of structural design scarcely to be expected in work so diversified. The company were fortunate to have adopted six or seven years ago a massive and symmetrical type for dynamo frames, without jogs, notches, or decoration. The supporting elements, including the armature bearings, field and outboard pedestals, are joined by graceful curves, affording a plain, smooth exterior.

In one sense this may not be a point for criticism, in another it is. Excellency of appearance in design usually indicates excellency of functions; at least this is a rule in most kinds of machinery, and no doubt applicable here.

The "Letter Type" of small motors, meaning a class designated by letters of the alphabet, from one to fifteen horse power, are of especially good design. They are of the bi-polar type, either shunt or series wound, and furnished with "starting boxes" and resistance coils.

LOCAL NOTES.

The Union Gas Engine Co., of this City, have been changing the design of their marine engines, discarding the closed box frame around the crank, and otherwise approaching more nearly to the type of steam engines for like purposes. To avoid vibration the cranks are set at 180 degrees, or opposite, so the movements of the pistons are opposed and balanced, which is a very desirable feature for use in vessels and boats where the attachments must be weak and vibration is transmitted synchronously throughout the whole vessel. The waste pipe is mounted centrally above the cylinders, so the whole structure is more symmetrical and accessible. The air for carburetting passes through channels cored in the main struts, so it is heated without separate apparatus for that purpose. Two engines of twenty horse power have been furnished recently as auxiliary power for sailing vessels, and it is not impossible that such an equipment will become the rule for all "coasters" in the near future.

We traveled recently on a steamboat the wheel of which revolved at the rate of eighteen revolutions per minute. The stroke of the engine was not more than six feet, perhaps less, and the piston speed about 200 feet per minute. The problem arose, why carry all this tackle, worth at least a dollar per day per ton of weight, when an engine of one fourth the weight would do the same work? It is true something would have to be added for transmitting and reducing gearing, also this gear is liable to wear and derangement, but with an allowance for all this, the balance is in favor of higher piston speed. To go to the other extreme, suppose the same wheel had been geared to one of Dr. Laval's turbines, or one of Parsons, each of which would far and away have exceeded the long-stroke slow engines in economy. The weight and room occupied would have been one tenth or less. The weight of the present engines with their connections are not less than eight tons, and the carriage of this worth at least \$4,000 a year.

The slough steamboats in California waters, those that crawl up to the heads of creeks that empty into the Bay of San Francisco, proceed on the crab method, backward. We have wasted some energy in deploring a thing so stupid, and wondering the pilots did

not know better. Inquiries made in the pilot house, where we are prone to "roost," having ourselves some experience in the steamboat line, usually brought out the answer that the boat could be better handled in that way, and it is true. On a recent trip, crawling up a slough in the dark, we set out for an analysis. The skipper said: "Don't you see, sir, we can pull the stern about from side to side by piling the water up against three rudders, and the bow must follow. We don't bother about that. The boat steers from the stern and at the stern. To change the course of the boat you swing the stern not the bow." We had seen all this over and over again, and had learned another lesson in experimental evolution. With all of its incongruous circumstances, working a steamboat up a California slough on an ebb tide is a "science."

Mr. James Spiers, President of the Fulton Engineering and Ship Building Works, in this City, has recently furnished for the evening *Bulletin* a short essay on "Industrial Education" that in the element of common sense far exceeds its volume. "Technical training" has for ten years past been like a harp of a thousand strings, ringing in the ears of everyone, useless mainly, and generally from sources incompetent to deal with such a subject. The aim and drift of it all is to make engineers, draughtsmen and managers of everyone, with no one left to do the work. Indeed one may question whether the main aim of this technical craze is not to avoid work. One of the greatest facts in an engineering or machine works is the skill, manual and mental, to properly carry on the processes. This is not learned in a college, or in a laboratory, and, as Mr. Spiers claims, why should it not be "taught" by actual practice? All works are managed by a mechanical head or heads, and there is no objection, and may be great gain, by such heads having technical training in the common sense of that term, but the main requisite is something else. There is no reason why such a school as Mr. Spiers suggests cannot be founded and succeed. We expect soon to publish an essay of his on this subject. His wide experience and observation should be of much use in this City and elsewhere.

In respect to piece work in machine making, treated upon in another place, an uniform system of estimating, or in other words, the collection of data as to the cost of doing work, is mentioned

as an impediment, and from some estimates that have come under notice recently we must conclude that there is more wanting than was supposed. Estimates, as two to one, indicate a fearful want of system, yet this has occurred in more than one case, and becomes a reason for urging some more careful methods than those now in vogue. Something depends on designs to be sure, but supposing these to be good, there are no reasons why such estimates should vary more than ten per cent. for any kind of work not involving experiments. We have examined estimates of more than \$10,000 worth of new work, that did not vary ten per cent.

The Pacific Electrical Storage Company, of this City, following the trend of the times, are turning their attention and converting their facilities to electric-power transmission and apparatus for this purpose. In one of their circulars at hand we find the following quotation from a statement of Mr. Leggett, President of the Bodie Consolidated Mines, in respect to an electric-transmission plant erected by him about two years ago :

“ In 1891 we expended \$21,360.75 for mill fuel, or an average of \$1,780.00 per month. In 1892 the expenditure for the same was \$22,758.30, or an average of \$1,896.52 per month. This entire expense is now being saved, and with no more attendance than with the steam plant. The saving effected will pay the entire cost of the installation in less than two years.”

By this we understand that the expense of maintenance and interest on investments were equal in the two cases. It is a wonderful result. The Pacific Electrical Storage Company will, of course, employ the accumulator system whenever the circumstances of distribution calls for it, and this, in the case of water-power plants of the smaller class, will be in all installments where water power is constant and consumption of current irregular.

The destruction of vines by the phylloxera in California, the low price of fruit, and possible conjection of the wheat supply, should cause a vigorous research in new lines of agriculture here, and no doubt will. Sugar from beets gives promise of a new field of great extent, and more permanent than either wines, fruit or even wheat, but this must have a limit, and there is no other more promising product than tannin producing plants. Tan bark must, in the nature of things, soon disappear as the principal source of tannin,

and be substituted by cultivated growths of some kind. Among these is "canaigre," a bulbous plant that is grown in a good many parts of the world, including Old and New Mexico. The market for this plant is already established, the price in Germany being about \$30 to \$40 a ton for the dried plant, top and roots. U. S. Consul Monaghan, at Chemnitz, Germany, sent a communication to the Department of State on this subject in February last, and inquiries directed to the Department of Agriculture, at Washington, will elicit further information about "canaigre."

The greater share of western towns, including nearly all in California, are spoiled by size. We have just examined one of 800 population that is laid out for 80,000, and the result is a want of streets and all else that a town should have. A tax of ten per cent. a year on all the property in the town would not maintain sewers, lights, water and other municipal necessities. "The town don't seem to grow at all," remarked one of the venerable inhabitants; "we have wide streets, plenty of room and low prices for land, but somehow things go backward." We answered that the town seemed to be doing well as a farming district, only the farms were too small, but as soon as the country around was all sewered, the roads paved and lighted, with water and gas, and electric distribution all over the county, then the town would be all right, or ought to be. This was a little too wide a proposition for the native until Woodland and Petaluma, near neighbors, were pointed out as having "their clothes made to fit."

There never will be discovered a more effectual way of spoiling a country town than by laying it out all over the neighborhood. They are handicapped, and cannot grow, and should not. It is the same with cities. Austin and Houston, in Texas, with a score of like places in the Southwest, are ruined in this way, at least for half a century to come, if not forever. The object is commonly land sales, and the result land without value, because the taxes are so high that nothing is left for rent. A condensed town is always a good one with modern improvements and reasonable taxes, a scattered one the reverse. In Scotland there are cities, Dundee among them, where there are fine public improvements and next to no taxes at all. The "canny" men entrusted with municipal government have gone into business for the town, and earn a sufficient revenue from public property, such as quays, warehouses and the like.

Mr. H. W. Wiley writes in the *Engineering Magazine*, for April, of the beet-sugar industry in this country, and gives some interesting statistics and a favorable prognosis for the future. The following table shows the growth of the industry and its division :

	Pounds.
In 1887.....	600,000
In 1888.....	4,000,000
In 1889.....	6,000,000
In 1890.....	8,000,000
In 1891.....	12,004,838
In 1892.....	27,083,288
In 1893.....	43,648,797

Location and product of beet-sugar works are as follows for 1893 :

	Pounds.
Staunton, Virginia.....	36,458
Grand Island, Nebraska.....	1,835,900
Lehigh, Utah.....	3,750,000
Norfolk, Nebraska.....	4,000,000
Alvarado, California.....	4,186,572
Watsonville, California.....	14,500,000
Chino, California.....	15,039,867

By the above it will be seen that California produced last year 33,726,439 pounds of beet sugar, or about 65 per cent. of the whole. The possibilities of the future are greatest here, and if land does not rise, as is customary, to a price equal to the capitalization of its maximum product, there is a bright future for the industry. The amount of capital invested in the factories is \$2,000,000, and the price of beets is on an average \$4.50 per ton. Mr. Wiley remarks of beet-sugar making in this country :

"Everyone who desires to see the prosperity of American machinery, American ingenuity and American agriculture should favor the development of the beet-sugar industry. There is no other way in which the plethora of agricultural products can be so readily relieved and renewed prosperity brought to our agricultural interests, thus stimulating every other interest in the land. The total consumption of sugar in the civilized world is not far from 7,000,000 tons, of which the United States uses two sevenths. Of the 7,000,000 tons over 4,000,000 are made from sugar beets."

Mr. J. B. Stetson, President of the North Pacific Coast Railway, and of the California Street Railway in this City, remarked recently that the whole excess of unemployed labor could at this time be

profitably and easily directed to making roads. This is a public work, one demanding, in California at this time, every possible effort that can be turned in that direction, and taxes assessed for such a purpose would be returned almost at once by the the increment in land and other values. There are few counties, perhaps none, in this State, fairly settled, that would not willingly assume the required assessment to improve their roads, and now is an opportunity to combine charitable and, at the same time, expedient expenditure. The free gifts to the unemployed, while directed in a commendable spirit, at the same time destroy the independence and manhood of the recipients, and it would be a hundred times better if in this State the various counties would by some means create a fund or credit, as Mr. Stetson suggests, to improve the roads, and thus furnish useful labor for the unskilled, also to a great measure for the skilled, who form a fair share of the unemployed.

COMMENTS.

Judge Caldwell in his Omaha decision, in respect to the strike against a reduction of wages on the Union Pacific Railway, has this reminder of the Credit Mobilier operations :

“It is part of the public history of the country, of which the court will take judicial notice, that for the first \$36,000,000 of stock issued, this Company received less than 2 cents on the dollar, and the profit of construction, representing outstanding bonds, was \$43,929,328.34. There would seem to be no equity in reducing the wages of employes below what is reasonable, and just in order to pay dividends on stock and interest on bonds of this character.”

He also, with much common sense, points out that an injunction to prevent men from interfering with the property or conduct of the railway's business was wholly unnecessary, because the law itself forbids such interference, and an injunction of court would lead to a misunderstanding of that fact.

Those who think the “balance of trade” in favor of a country, is a sign of prosperity, can now “rise to explain” why in the last eight months, when the balance in our favor has been \$218,000,000, the prosperity has failed to co-operate. The balance of trade, sometimes called the old “mercantile theory” is based on a delusion as

to what money is. When we get in more money than we send out then the balance of trade is said to be in our favor, and vice versa. A balance of goods or wealth in our favor counts for nothing on this theory ; it is money, gold or silver that measures our gain. If a merchant was to estimate his business on the same method, that is, by the amount of cash he received and paid out, he would be called a fool. The cash account is a mere incident in his accounts, and required only to adjust balances, but when it comes to the National finances, then balance of trade people have a different theory, a kind of child's theory, explained away more than a century ago by Adam Smith, and since by nearly all sensible people.

The War Department, it is announced, will again invite competitive trials of rapid-firing guns, and the chances are that Mr. Maxim, who now lives in England, will not compete. He has written savagely, and no doubt truthfully, of unfair treatment in former cases by the appropriation of his inventions by one ruse or another that would disgrace a private company or firm. In one case he claims to have expended \$35,000, of which he never received a penny in return. His smokeless powder was sent by invitation to the U. S. Government, copied and not even the examples paid for. Other cases are mentioned of the appropriation by this Government of his inventions, and is contrasted with his treatment in England, where he is paid fairly for whatever he supplies to the government there. Some explanation of these matters may be forthcoming, but we must confess to not knowing of any instance where an inventor has in a business way been fairly treated by the Government in dealing with a patented invention. Mr. Maxim is a native of Maine, and at the head of the Maxim-Nordenfeldt Gun Company in England.

In the late Report of the Commissioner of Patents there are the following words :

“The division of cases is not required upon the basis of Office classification, but only when an applicant attempts to include two or more distinct inventions in one application, and the patent for that reason would be void.”

This seems all right, and is, if it were not that the question is in such cases a debatable one as to whether there are two or more “distinct” inventions, and a consensus of opinions among those who

have had their cases divided will show a belief that divisions are made to suit classification. In most countries patents are confined to one organized machine, process or product. For example, an improvement in elevators can comprehend various modifications if these relate to different conditions or methods of working, so long as the invention is confined to elevators, or devices for raising and lowering passengers and goods, but in the American office a patent on a valve and another on a piston must be co-related and connected or the case would likely be divided.

In the debate on the navy estimates in Great Britain, Mr. Allan, a Scotch member, and Mr. Penn, of Penn & Sons, gave some plain talk on the engineer service of the navy that will fit generally all over the world at this time. Mr. Allan's speech was full of new ideas, and among these the proposition that the modern battle ship is not an "improvement" on the old "line ships," but a different thing altogether, is a new engine of war, and that the attempt to govern this by the old rules of the war marine, such as formerly existed, is absurd. A man's pay and rank in the navy should depend upon his responsibilities Mr. Allan contends, and this no one can logically dispute. This problem, like all others affecting national interests, must fight and contend with vested rights, and exemplify Voltaire's proposition that "nearly all useful legislation consists in the repeal of bad laws."

F. R. Mason, U. S. Consul General, at Frankfort, Germany, writing of the grain supply in that country, where we have for a time been sending one half the wheat and one sixth of the flour imported there, predicts that the new treaty made between Germany and Russia will greatly reduce the American trade in these things. For a year past the Russians and Germans have been playing the same game, described by Bastiat, between "Fooltown" and "Boytown," who attempted to injure each other by cutting off trade between themselves, and in the end ruined both towns. First Russia and then Germany levied specific duties until the matter became ridiculous, and until the commercial community became disgusted, especially those who were cheated by the changes in prices. Now Russian wheat bears the same rate of taxation as that imported from other countries, and our quota must fall off. This tinkering with prices by means of customs reaches far and wide. The German tariff will indirectly cause much loss in this country.

The "industrial armies" in various parts of the country form the subject of both joking and serious thought. It is the latest and by no means the least among manifestations of labor disturbance, and while the particular fact may not be of serious import it is suggestive of more energetic research and action in the way of correcting the economic causes that lie at the bottom. These are many, comprehending the whole trend of modern commercialism and corruption, the union of business and politics with laws and conditions that must soon overturn the social system of civilized countries. Our country, by reason of the character, diversity and extent of legislation, is peculiarly subject to disturbing influences, and fortunately with an equal power of removing them. This, people feel and know, hence the boldness of demonstration. It is a good time to stop and think. Perhaps things will "settle down," perhaps they will not. If not, then the political power of the country will probably in the near future pass into new hands, more honest if less capable.

The following sentence was picked out of some comments in *Engineering*, London, on the forthcoming railway Congress to be held in London. It contains in suggestion enough to make a book.

"Perhaps some day our educationalists, a class always many years behind the age they live in, will awake to the fact that it is better to instruct in things that exist rather than in dead and dry immaterialities. Then the average man will not find nine tenths of those things that surround him utterly inexplicable. With a wider horizon his daily life will assume a tenfold interest and intensity."

Secular education has followed on the lines of law and theology, both of which regard with some repugnance any proposition capable of absolute demonstration. This cannot be charged broadly to modern schemes of education, but there is some analogy certainly.

The steel castings companies have combined, and the main point in the compact is that when there are not orders to keep all the works going some of them are to be shut down. It is not added that consumers must pay a price to pension the idle works, or, in other words, if anyone by mistaken judgment builds a steel works for the product of which there is no market, the public must pension him and maintain the investment. This is socialism, and the worst form of it. Competition that is pleaded in extenuation is caused by the very remedy applied, a fictitious price and consequent inability

to sell anywhere but in the home market. People are becoming a little tired of this policy. Wheat sells in this market at less than a cent a pound, and grapes last autumn brought as low as \$6.50 per ton, but a combination such as the above was not thought of or possible, besides how is comparison to be made between the interests of a dozen of steel-casting foundries and as many thousand consumers of the castings; but it will not last long.

ENGINEERING NOTES.

Some method of controlling and distributing power is among the inevitable changes of the near future, not only is it becoming necessary on grounds of economy but of public safety. A steam boiler of large power situated beneath valuable buildings filled with people, is not much longer to be permitted. A result of this is seen in the recent catastrophe in New York, where a boiler 44 inches diameter, 18 feet long, exploded, killing outright seven people and wounding ten more, also killing thirty horses, and destroying \$40,000 worth of property. This is one of the worst land explosions on record, caused by corrosion that had reduced the shell in one place to a tenth of an inch in thickness. The boiler was level with the sidewalk forty feet from the street, and tore out a section as wide as one building through to the street. One source of danger is inclosing a boiler within strong walls and a heavy building over the top, as in this case.

The enormous amount of garden hose used on this Coast, five times as much no doubt as among an equal population in the Eastern States, has made this a fertile field for what may be called "fake" qualities, and a dumping ground for the bad and imperfect work produced in Eastern factories. Bad hose should be repressed on moral grounds. It induces profanity, even among the most exemplary citizens, is a fraud and theft of people's money. In purchasing hose it is a good plan to secure a short section cut from the end, and take this down for inspection. The quality of cementing and saturation of the web is at once apparent, so also the seams, which if not perfectly made will pull open with a moderate strain. Some examples of hose made by a company in Cleveland, Ohio, have been sent in by the Simonds Saw Co., the agents here, and on "disintegrating" the hose we find that the inner seam, if there be one, is so

cemented as to equal in strength the rest of the sheet. It is called seamless, which we are not prepared to admit, but certainly it is not weakened by a seam. The life of a hose is dependent mainly on whether the water can find its way to the web, or upon the integrity of the lining.

Mr. William Mather, of the firm of Mather & Platt, Salford, England, in February of last year changed the hours of work in their establishment from 9 to 8 hours a day, or 48 hours a week, without change of wages, makes a report in which he claims a gain in every respect, which is possible, but leaves a question whether the same result would follow in other cases. We think it would not. The firm are engineers, makers of engines, electrical and other machinery of various kinds, most of which, if not all, is done by estimate, or piece work, to use our term for it, and this makes a wide difference. The statistics are complete, extending to wear and tear, lubricants, files, waste, lost time, product and expense of all kinds. Lost time fell from 2.46 to 0.46 per cent., and there is no doubt of the result in this case, and would not be in other cases with the same class of men and methods; both are exceptional, however.

Drawings have now been published of the steamers constructed by Messrs. Doxford & Son, in Sunderland, England, that are called here "turtle back," but from appearances differing so much from Captain McDougal's boats as to require a new name, and are called "turret steamers." Eight of them have been commenced, and several completed. They are immense barges, without any marked departure from ordinary lines above water, except the insloping bulwarks. There is deck room enough to work the vessels from, and the stem, run, and general contour is not displeasing in appearance. The main object of these vessels is to carry wheat in bulk, and the technical idea involved in the design is an approximation of the box girder or tubular form to secure strength and save material. We hope to hear Prof. Sweet's opinion of the ships in this respect. The mathematical determinations of this form for structures seems to fall far short of the real fact, indeed is so different that what is known of the matter, especially as to torsional resistance, is by observation.

Practical rules for mechanical operations are apt to be written by people who have just found out how to perform them. In a contem-

porary we find instructions for balancing pulleys, in which the workman is to mark the high or light side with chalk, and then fasten a piece of iron in the pulley with wax, or by a wooden prop, and try until the right weight is known; also that in some cases there are two heavy spots requiring two counterweights. This last is a "settler," so also the method of finding the weight of a counterbalance. In every shop we have ever been in, and that is a good many, the weight of a balance is ascertained by applying clay or putty on the light side of pulleys until a balance is attained, then removing the putty or clay, putting it on a common balance and trimming the piece to match. The two points to be balanced we leave to the writer and the laws of dynamics, with the suggestion that if two light points can be found, which is doubtful, a counterweight somewhere between them might answer.

In an exhaustive trial of a pumping engine of 1,000 horse power at Milwaukee, Wisconsin, erected by Messrs. E. P. Allis & Co., for that City, the results attained were phenomenal, and in excess of anything on record at this time. The duty in foot pounds per 1,000 pounds of dry coal, was 143,306,470; and for 1,000 pounds of feed-water, 152,448,000. Fuel per indicated horse power was 1.23 pounds, and per dynamic horse power, 1.36 pounds, and the consumption of water was 12.13 pounds per indicated horse power per hour. Professor Thurston, from whose report of the matter the above quantities are taken, says the efficiency is but 25 per cent. below that of an ideal engine, and lacks that much only of perfect performance. This high result involved pumping apparatus that by its construction was limited to a piston speed of 200 feet per minute. If the observations and data are correct, and there seems no question of this, the feed water consumption at 12.13 pounds "beats the record." The engine is triple expansion, with cylinders 28, 48, and 74 inches in diameter, with a stroke of 60 inches.

Messrs. William Jessop & Sons, the celebrated steel makers at Sheffield, England, have at their branch in New York an interesting collection of "fractures" of steel bars, mainly of tool steel made by the firm. This collection has been prepared for presentation to the Michigan School of Mines, where the officers with their usual energy will, no doubt, prepare photograph views for publication. The examples are arranged in a fine cabinet, and the idea is worthy

of repetition. The most severe use of tool steel is in mining implements where the edges are subject to continual attrition, and the whole implement driven by blows. Messrs. Jessop & Sons make a speciality of drill steel for mining purposes, and it is to be trusted that the expense involved in their courteous gift to the Michigan School will be compensated by the knowledge thus afforded of the excellence attained in their manufacture.

Why the makers of centrifugal pumps in England continue to arrange them with a forked suction to enter with a short angle into each side, is something not easy to find out. In many cases, even among noted makers, the pumps are wholly supported by a flange around the gland sleeve at one side, a most unsymmetrical and weak design. The pump spindle passes through the two suction pipes, which one would think divided and obstructed enough without this. A path of the water, shown diagrammatically, will violate well-known laws relating to the flow of fluids, and the efficiency is considerably reduced by such a design. We are quite confident that there are a number of makers of centrifugal pumps in this City who can attain five per cent. greater efficiency than is possible with these cramped English pumps with divided suction pipes and "hung up by one elbow."

The American and English locomotive cabs, form a subject for continual letter writing and argument, generally by people who know little or nothing of the circumstances in both countries. The British workingman is a chronic grumbler, and any want of comfort in his cab would soon be heard from. In a country where it is not found necessary to warm workshops artificially, there is more apt to be fault found with cabs being too close than too open, and where a man has to watch signals instead of his engine, cab arrangement is likely to be different. The runs are short, and an engine is not supposed to demand attention under way, so that cab doors, running boards etc., are not required, neither are spring seats for the engineer and fireman. In this country, where the climate is much more severe, the runs long, and the attendants are expected to keep up their engines, a different cab is required. We have known and conversed with a good many "drivers" in England, but never heard any complaint of cabs, but no little about other things, even where conveniences seemed complete.

If some of these cab reformers were to go over English works, railway and other, they would be astonished at the exactions and requirements of the men. Between dining rooms, kitchens, halls, hospitals, stores, and what not, that are provided for or by workmen, their comfort seems to be the main fact about such works. American travelers often go by the way of Queenstown on their journeys to England, and to these, such as are interested, we suggest a stop at Dublin and a trip out to the Inchicore Works of the Great Southern and Western Railway of Ireland. This would be a matter of the greatest interest. It will be found that the "personality" of the workmen is one of the important elements there, also, and for this very reason perhaps, that the Inchicore Works is a kind of training school from which is drawn a great many skilled men as officers of other railways. These men understand very well what is required in the way of engine cabs, and, no doubt, have what they want.

We are not disparaging our American cabs. They are a wonderful contrivance, and an evolution of circumstances, hence right, but our contention is that other people are apt to be the best judges of their own requirements, and *ex parte* criticisms are "provincial." One of the last things a man acquires in the way of education is impartiality, and a proper estimate of his own environment. It is hard to arrive at without some travel or a strong judgment, but even this fact does not render international criticism less repulsive. The practice and methods of a country can always be safely measured by the general skill of that country and its place in the arts, such as fall in the field of criticisms. For example, when a college professor in this country thinks that Vanderbilt or Gould could reform the German railway system he is only exposing his provincialism.

We find among a large number of papers, letters, and essays on balancing locomotives, the following letter, which illustrates how all such problems can finally be solved in words instead of formulæ, and take a really practical form :

"Practical success confirms the contention for sufficient counterweight to equalize longitudinally the accelerations of revolving and reciprocating parts, employing for the purpose one, two, three or more axles, as the obvious limitations necessitate ; if the vertical disturbances can also be balanced, well ; if not, it is no great matter,

provided always the excess of vertical effort is not sufficient to bring about those results which have been previously indicated; the spring will be absolutely indifferent whether the load it imposes on the journal is resisted wholly by pressure at the wheel tread, or partly by pressure at the tread, and partly by the vertical action of centrifugal force. With respect to the possibility of compression being so nicely adjusted as to transfer the inertia strain of the moving parts wholly to the frames, it will be conceded that this *may* happen, not necessarily by design or continuously, in which case the pull of the counterweighted crank must be balanced by the pressure on the horn blocks, so that the leverage of the inertia strain is considerable. The degree of remark excited by a design is generally proportioned to the extent of its divergence from existing practice. There is, however, a less desirable but more frequent prominence in the 'remarkably commonplace' which would avail nothing to discuss further."

We note in the *Iron Age* a description of some machinery for making bent cranks by hydraulic pressure, operating dies in four directions, which is not a new matter here or worthy of comment, except to say that it is quite time such cranks were produced as an article of regular manufacture by iron working firms, as is done in England and some other countries. Bent cranks are good ones, and best of all for cases where the required width can be provided for between pillow blocks, and can be so cheaply made as to not advance the cost of the iron more than 25 per cent. above that of the bars from which the cranks are forged. They do not look quite so neat as slotted rectangular cranks to those unaccustomed to the bent form, but, as before said, they are good and cheap, and the wonder is that some firm or company does not engage in the manufacture and supply the trade.

ELECTRICITY.

NOTES.

The "electrical press," a term that is now admissible, has been congratulating the country upon the fact that the storage battery interests had now settled down into peace and amity, but on the heels of this comfortable announcement comes a report of a suit instituted by the Consolidated Electrical Storage Company of Philadelphia, against the Chloride Battery Company, petitioning for an injunction to restrain the latter named company from selling their

product. The consolidated company are licensees under the Brush patents, and as we understand are connected with the Edison interests, so that a vigorous effort will be made no doubt to compete with each and every form of accumulators brought forward. We know nothing of the points at issue, but if the complaint rests upon the Brush patents, it must relate only to mechanical construction and methods of supporting the active material on the electrodes.

The Metropolitan system of street railways, in Washington City, that have a course five miles long, through the heart of the capital, have been struggling for years to develop a successful system of accumulator batteries for propulsion. It seems that nine different systems have been tried during four years past, and except in two cases the range of service did not exceed 700 miles. In these cases 2,227 and 3,243 miles were attained before the batteries gave out or were ruined. This is not encouraging, and is also inferior or indeed not comparable with results elsewhere attained, and warrants the claim sometimes made, that this country is far behind in the accumulator branch of electric progress. We have no corresponding statistics from European attempts, but there has certainly been more success than at Washington. The cars when equipped weighed six and a half tons.

Mr. Alexander Siemens, in a late lecture on electrical matters, said he had just inspected some motors made by his firm for a street railway line, that had run 26,000 miles without repairs and with the same brushes. He also mentioned a small motor employed for pumping that had been in charge of a gardener for fourteen years without repairs, that need be considered. He claimed an efficiency in electrical horse power of 84 per cent. and a brake horse power beyond the motor, or of actual application, 70 per cent. which is more than can be utilized with common transmitting gearing. The increase of economy in electric transmission, has advanced faster than the most sanguine expected, indeed all methods of transmitting have made a wonderful advance in the last few years, and the economy of power generally is one of the principal features of our time.

The employment of accumulators at central stations is rapidly extending in Europe. There were in England at the beginning of

this year twelve principal stations thus fitted out, but the widest use is in Germany where there was at the same time thirty-three stations employing accumulator batteries, six also in Holland and Belgium and three in the Scandinavian countries, six in Spain and Italy, two in Switzerland and seven in France, for the most part in the largest plants. This system has much to recommend it in the saving of capacity or power of a plant, and in operating expenses by always working with a maximum load, also dispensing with one watch of attendants. It is curious that more is not done here, but we suspect that the want of durability in the batteries, or the fear of it, has been one cause of delay. The load curve or diagram is usually a distorted one resembling the profile of a mountain. The accumulators remove the apex.

There are now in use in Paris twenty-five storage-battery cars and fifty more to be added. Two lines now have cars propelled in this manner, and a third one, three miles long, is to be equipped in the same way. The batteries used are called the "chloride accumulators." The cells are of hard rubber, each containing eleven plates, $7\frac{3}{4}$ inches square and $\frac{1}{4}$ inch thick, the total weight of the cells being $38\frac{1}{2}$ pounds each, which seems very light, but as there are over one hundred on each car the gross weight is about two tons. The carrying capacity, or the seating room, it may be called, because all passengers must be seated, is fifty persons for the main car and a "trailer." One charge of the batteries is good for 40 miles. This seems to be, this far, the most successful venture with the accumulator system, and is under favorable circumstances. The French made pneumatic transmission a success, and may do the same in this venture. Their organization of such things is perfect.

MINING.

NOTES.

Mr. I. B. Hammond, an experienced engineer of Portland, Oregon, called at this office recently and propounded a question yet unanswered, namely : Why cannot steam as an elastic gas, controllable under various analogous conditions, be directly applied to operating ore stamps? Mr. Hammond is of course well acquainted with steam

stamps, such as now exist in this and other countries, but meant our common stamp batteries and the avoidance of steam engines, wheels, belts, pulleys, cams and cam shafts. It does seem strange when one comes to think of it. We first use steam to produce reciprocal motion, convert that to rotary motion, transmit this to a second shaft, and then reconvert to reciprocating movement. Certainly a "long way around." It should be possible to match the diagram of movement and force in a stamp stem with a corresponding one of steam applied on a piston, or come near doing so. Mr. Hammond is now engaged on this problem.

That there is an enormous amount of gold to be procured from the river beds of the auriferous regions on this Coast every one admits, and the attempts this far to secure the gold are by no means as successful as could be expected, nor as perfect as have been attained elsewhere if accounts are true. The Sacramento, San Joaquin, Feather and American Rivers afford excellent opportunities, and, no doubt, the coming season will see better attempts than in the past at river mining. Suction pipes alone hardly meet the requirements for securing the spoil, and either chain buckets, or a combination of these with pumps, is more likely to be the successful method where coarse material has to be raised or dealt with. The pumps of the centrifugal type should be designed for the purpose, and to be well adapted cannot attain a high efficiency, and this is not important. The head is small, and it is much more important to have a pump that will not break or clog than one of refined proportions.

MISCELLANEOUS NOTES.

Those who know anything of the strength of ice will be amazed to read of a boat plowing through fields of it twenty-seven inches thick. This is what they do in the Straits of Mackinaw, Lake Michigan, with a train ferry steamer. The vessel is 269 feet long, 51 feet beam and 24 feet deep. The hull is of wood, immensely strong, the frames 12×24 inches at the keel, and fifteen keelsons 14×14 inches. The engines are of 2,500 horse power, but how with all this a vessel can be propelled through ice twenty-seven inches thick is a mystery. A railway train could be driven over it.

The common method is to crush the ice downward by means of a raking stem and bow, but the *Ste Marie*, from a photo plate in the *Marine Review*, seems to crush straight through.

There is not one in a thousand, who will at first thought consider the low price of silver as being a cause of counterfeiting, but it is directly so. At the present time anyone who will coin silver just as good as the United States mints produce, can make thirty cents on a dollar by such operation, and this is profitable business certainly. The common idea of counterfeiting, is that of issuing base coin, but there is no need of that if by any means the current value of coins is maintained above the prices of the metal they contain, and the wonder is that "money factories" have not sprung up long ago under such circumstances. Such a factory has been started in Omaha, where some astute people have produced good money and dispute the right of the Government to maintain a monopoly of the business. Here is a new problem in the cheap money system. There was once in Western Virginia, a money maker who contended that his money was better than that of the Government.

Two thirds of the losses due to bad investment, can be traced to either ignorance or neglect of certain rules as ascertainable and plain as a problem in simple arithmetic. To guide people in investments of an industrial kind there are plenty of skilled men conscientious and exact, who can with almost absolute certainty pre-judge results, but the investor has no use for these men, he prefers his own unqualified judgment and a faith in false economic laws. This thought comes in connection with the Fort Payne Co. in the South, where credulous investors paid in \$5,000,000 on an iron making scheme when the natural resources were not plenty or favorable. The *Engineering and Mining Journal* says, fire-clay and kaolin are the only minerals at hand, coal, ore, etc., were less accessible than at other places, a fact that any competent engineer could have ascertained in a week and made no mistake. This was not done. "Boom" methods were substituted and now the whole thing has been sold for \$60,000, no doubt all it is worth.

Mr. J. W. Glead, a lawyer of much ability, has contributed to the *Forum*, for April, an article under the head "Is New York more

Civilized than Kansas?" Few will read this as an emulative effort, but many will read it in amazement in so far as New York statistics. It is a fearful showing. Mr. Glead contrasts Senators Pepper and Martin, of Kansas, with Hill and Murphy, of New York, and certainly with an enormous advantage on the side of Kansas. Mr. Pepper may be a man with some extraordinary delusions of an economic kind, but he is honest. He was elected free of any charge of bribery, and is one among a few of which this can be said in recent years. What would Kansas think, or what would most other States think, of such a Senator as Murphy of New York, or even David Hill? Kansas has 90 per cent of American-born citizens, 70 per cent. born of American parents. New York has less than 58 per cent. of native-born citizens, and only 20 per cent. born of American parents.

The snow sheds on the Canadian Pacific Railway are constructed on a different plan from those in the Sierra Nevada Mountains. The latter are made like houses to protect from snowfall alone, but the Canadian sheds are to ward off avalanches. The mountains in the Selkirk Range, and all along the line, are much steeper than along the southern range, and slides are commonly a mixture of stone, earth and snow of great weight and force, so the sheds become chutes instead of covers. They are made of immense timbers, closely packed, with four sets of diagonal braces, and with a base from 50 to 60 feet wide. The slope is all one way, the same as the mountain sides, so the avalanches are deflected and jump over the railway. In some places there are a line of rails outside the sheds so as to avoid the smoke and annoyance of them in summer. The snow and ice sometimes remain until June, but there is seldom any accident or detention, so completely is the line guarded.

We supposed until now that the emery wheel or grinding machine works of this country were the most extensive, but a circular from the Naxos Union Co., Frankfort, Germany, changes this opinion. The circular referred to contains seventy-five distinct illustrations of machines made for grinding with emery wheels, covering all imaginable uses. A view of the works given, if correct, shows a very complete establishment, with fine grounds and architectural display not common in works of this kind. Another German circular received at the same time, devoted to *rippenheizkörper* (rib heat-

ing bodies), shows that the radiation and absorption of heat by surfaces has not only been studied out but reduced to a separate manufacture. It consists in projecting flanges around pipes to operate on what is sometimes called the "pot-leg" theory, which assumes that a pot with legs boils sooner than one without them. The method is quite common everywhere in heating and cooling devices, but as we believe has not become a "manufacture" except in this case.

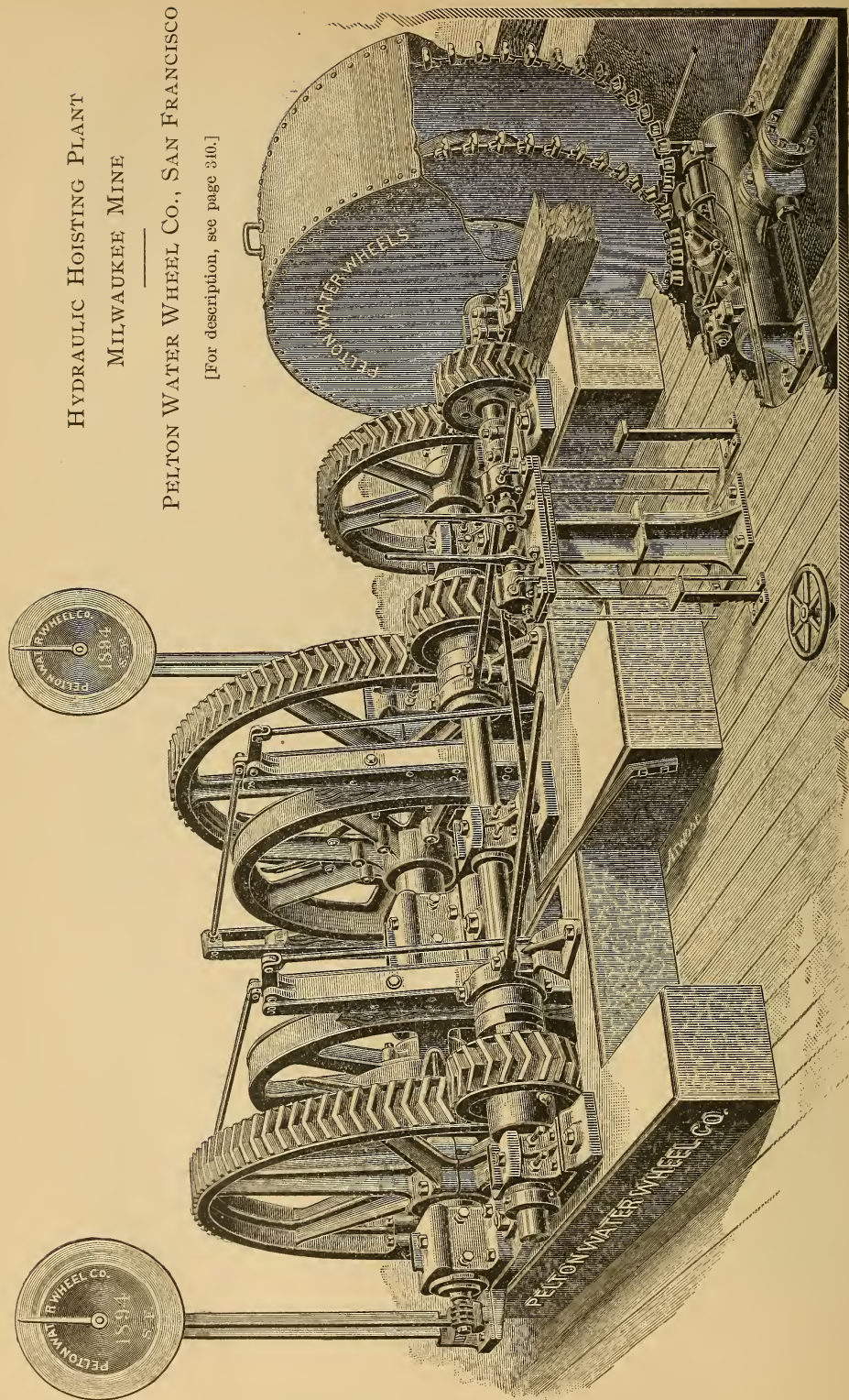
Louis Kossuth is gone, but not his life's work ; that shines on. Even the slight he received in this country, after an American vessel had by order of Congress, been sent to bring him from Turkey, has caused no blur in his record, but it did on his mind and sympathies. As a boy we heard his eloquent address from the steps of the Burnet House, in Cincinnati, forty years ago, delivered in our language, learned in a prison from a few books. Kossuth was an apostle of human freedom, without qualification of country, color, race or condition, and hence met with a cool reception from the slave holding element in 1851. His misfortune was in not having the power to maintain the independence of Hungary, now an integral part and half of the Austrian Empire. He was defeated by arms, and fled to Turkey, where the Sultan protected and refused to deliver him to the Hapsburg power. The United States sent a war vessel to bring him to this country, but he went from here to England to live, where he remained for many years, finally returning to his native land where he died in March, at an extreme old age.

By a recent report the earnings on \$6,639,000 invested in Southern cotton mills was last year 8.8 per cent, declared in dividends, which is certainly an exceptional showing for an industry of the kind, especially as there must have been a good deal carried to capital account from earnings. This is in queer contrast with the wool industry. Cotton is free from custom duty, and wool heavily taxed. Similarly we have free trade in hides and a high duty on pottery. These industries contrasted, show the same result that is just the opposite aimed at, and claimed by those who think a tax on imports builds up industries. What American manufactures need, is free coal and free crude material of all kinds. They will manage the rest, but that would soon cut off Federal taxes by stopping imports.

HYDRAULIC HOISTING PLANT
MILWAUKEE MINE

PELTON WATER WHEEL CO., SAN FRANCISCO

[For description, see page 310.]





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JOHN RICHARDS, EDITOR.

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ON THE TRANSMISSION OF POWER.

With an Analysis of Compound Air Compressors.

BY A. E. CHODZKO, M. E.

No. II.

COMPOUND AIR COMPRESSORS.

As stated in the preceding article, the most successful way of increasing the efficiency of air compressors is by compounding the cylinders, or by a distribution of the total work required in compression between several distinct cylinders.

The principle of compound compression can be described as follows: Suppose that a certain volume of air at a temperature T_0 is to be raised from a pressure P_0 to a pressure P , P_0 being most commonly the atmospheric pressure of 14.7 absolute pounds per square inch.

In ordinary or single-stage compressors the free air is introduced and compressed in one cylinder, and then delivered directly into a receiver. In the compound machine this air is compressed in a first cylinder from its initial pressure P_0 to a certain pressure P_1 , smaller than the terminal pressure P ; there will be a certain amount of heat generated by this compression, less, however, than in a single cylinder machine.

The air at pressure P is forced from the first cylinder into a refrigerator, wherein, without losing its pressure, it is cooled down to its primitive temperature T_0 , its volume being reduced accordingly. It then enters a second cylinder, where it is compressed from P_1 to another pressure P_2 , still smaller than P , then cooled down again to T_0 , and so on compressed by successive stages until the final pressure P is reached, and the air delivered from the last cylinder into the receiver.

Compound air compressors thus consist of any number n of cylinders, whose size is gradually decreasing, with $(n - 1)$ coolers interposed between them, the air being always cooled down to its primitive temperature before passing from one cylinder to the next. The diagram Fig. 1 represents this series of successive compressions and of intermediate coolings.

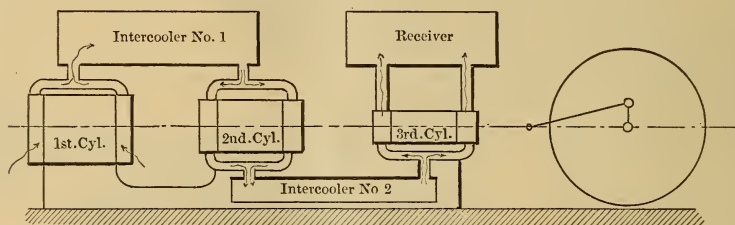


FIG. 1.

The result of this combination is that the total heat of compression to be got rid of is divided into several fractions, the series of cylinders presenting to the cooling water, destined to absorb this heat, a greater surface than would a single cylinder, and the air being always cold when entering any cylinder in the series.

There is not, at a first glance, any special rule governing the size of the successive cylinders, and consequently the values of the intermediate pressures, and these quantities might be chosen at random, but when adding the partial amounts of heat generated in the successive cylinders, their sum, which represents the total heat of compression, and consequently the total work, would not, of course, be the same, whatever might be the sizes of the cylinders, and since accepting the complication due to their larger number, it is expedient to know whether certain particular sizes and intermediate pressures do not give a minimum value for the total work of compression.

Compounding has so far been done with two successive cylinders, and one intercooler for usual air pressures ; however, three cylinders

are employed for high pressures, and the principle of compound compression being independent of the number of cylinders, the question will first be solved generally.

Calling :

J the Joule's equivalent = 772.

W the weight of air introduced in the first cylinder.

C the specific heat of air at constant pressure = 0.2377.

$T_0, T_1, T_2, \dots, T_n$ the absolute temperatures corresponding respectively to the absolute pressures.

P_0, P_1, P_2, \dots, P , the absolute initial pressure in each respective cylinder, the total adiabatic work (compression and delivery) effected in the first cylinder will be :

$$J W C (T_1 - T_0) = J W C T_0 \left(\frac{T_1}{T_0} - 1 \right)$$

The total work in the second cylinder will be :

$$J W C T_0 \left(\frac{T_2}{T_0} - 1 \right)$$

in the third cylinder :

$$J W C T_0 \left(\frac{T_3}{T_0} - 1 \right)$$

and in the n th or last cylinder :

$$J W C T_0 \left(\frac{T_n}{T_0} - 1 \right)$$

Since the initial temperature T_0 is the same in all cylinders, as J, W, C are constant quantities, and as T_0 , being the temperature of the atmosphere, can also be considered as constant at a given place and time, the minimum amount of work will be developed when the sum of the partial work is a minimum, or when

$$(T_1 + T_2 + T_3 + \dots + T_n)$$

is a minimum.

Now 1.4 being the ratio of the specific heats of air at constant pressure and at constant volume, we know that in adiabatic compression the ratio of the final to the initial absolute temperature is equal to the ratio of the final to the initial pressure, raised to the power ^{0.286}. Writing this relation for everyone of the (n) cylinders of a compound compressor, and multiplying respectively the first and second members of these (n) equations, we find that the product of the terminal temperatures depends solely upon the initial temperature, the atmospheric pressure and the receiver pressure, *i. e.*, that this product is constant in each particular case.

But the sum of a number of variable and positive factors, whose product is constant, becomes a minimum when these factors are equal; the total work of a compound compressor will therefore be as small as possible when the initial and final temperatures are the same in all the cylinders, or, in other words, when the total work is equally divided amongst all the cylinders whatever be their number. As before stated, the two cylinder compound is by far the most commonly used, and it shall be dealt with more particularly.

Without developing the details of the calculations, it shall be stated that in this compressor, which has one intercooler, the first cylinder, into which the compression begins, is called the low-pressure cylinder, and the second cylinder, wherein the compression is completed, is termed the high-pressure cylinder.

The intercooler pressure must be a mean proportional between the atmospheric and the receiver pressures, *i. e.*, if P_1 designates the absolute intercooler pressure, P_0 and P the atmospheric and receiver pressures, we must have :

$$P_1 = \sqrt{P P_0}$$

The volume V_0 of the L. P. cylinder, and the volume V_1 of the H. P. cylinder, in which the initial temperature is the same, are connected by the isothermal relation :

$$V_1 = V_0 \sqrt{\frac{P_0}{P}}$$

If the stroke of both these cylinders is the same, which is generally, but not necessarily the case, the equal re-partition of the total work between them leads to conclude that at any point of the stroke the loads on both pistons are equal; and if we compare the terminal load on the piston of an ordinary compressor to the aggregate terminal load of a tandem compound machine raising the air to the same receiver pressure, the ratio of the former to the latter will be found equal to :

$$\sqrt{\frac{P}{4 P_0}} + \frac{1}{2}$$

P and P_0 being, as above, the absolute receiver and atmospheric pressures, if $P = P_0$, *i. e.*, if there is no compression at all, this formula becomes equal to 1.

Comparing now the work developed in a single cylinder and in an equivalent compound set, we shall find that when the ratio of the receiver pressure to the atmosphere is :

5 6 7 8 9

and if the work developed in the compound is 1, the adiabatic work with no cooling in the single cylinder is respectively :

. 1.131 1.147 1.16 1.175 1.185

showing a gain in favor of the compound of :

11.5% 12.8% 13.8% 14.9% 15.9%

which increases, therefore, with the receiver pressure.

If the cooling during compression is as perfect as practicable, *i. e.*, if the compression curve is $p v^{1.2} = \text{constant}$, the work of the compound being 1, the work of the single cylinder is respectively for the above receiver pressures :

1.069 1.081 1.089 1.095 1.102

showing a gain in favor of the compound compressor of

6.4% 7.5% 8.2% 8.7% 9.2%

When the cylinders are cooled externally by means of a jacket, which is an almost general practice in America, the percentage of work gained by the use of a compound compressor can be taken, with a convenient degree of approximation, as :

8.95% 10.2% 11% 11.8% 12.5%

These figures show that the economy of compounding for the usual air pressures ranges from 10 to 12 per cent., by no means a neglectable quantity, especially for compressors of great power.

It may be here noticed that the preceding results were based upon the assumption that no variation of pressure occurred between the two cylinders ; in practice the capacity of the intercooler has some influence upon the intermediate pressures, comparable, to some extent, to the "drop" that takes place in the receiver of a compound steam engine.

The relative connections of the pistons, *i. e.*, either tandem set or quartering, also affects these variations of pressure, whose effect is to impair the equal re-partition of the total work between the cylinders.

These points, whose close investigation would belong to a didactic treatise on the construction of air compressors, can only be mentioned here.

It will be found that the gain increases with the number of stages adopted for the compression ; but it should also be borne in mind that the various resistances increase with the number of cylinders, to say nothing of the cost of purchase and maintenance ; discrimination must therefore be used in combining these conflicting

elements, and it is hardly probable that the use of a triple compound machine would be advisable as long as the terminal pressure does not reach 9 atmospheres absolute, and even then unless the compressor be of considerable power. But as a rule, and in all cases, it appears that the single-stage compressor absorbs more work than the compound to produce a given amount of air at a given pressure.

Summing up the above conclusions we see that compounding increases the efficiency of a compressor on two distinct grounds: In the first place the heat generated during the process of compression is thus more readily absorbed, because the aggregate cooling area is larger in the compound, whose L. P. cylinder is always the same as the cylinder of the single-stage compressor of the same capacity and piston velocity, and also because the amount of heat subject to the action of this cooling area is smaller.

This, however, is not the only advantage ascribable to the compound machine; it has also been shown that the maximum piston load was less in this latter compressor than in the former. The result thereof will be best understood in a practical illustration.

Fig. 2 represents the adiabatic cards of a $12'' \times 16''$ single-stage machine, and of a tandem compound ($12'' + 7\frac{3}{4}''$) $\times 16''$, both compressing to 70 pounds gauge; it also shows the expansion curve in a $12'' \times 16''$ steam cylinder, developing with steam at 80 pounds gauge, a work equal to that of the single-stage air cylinder.

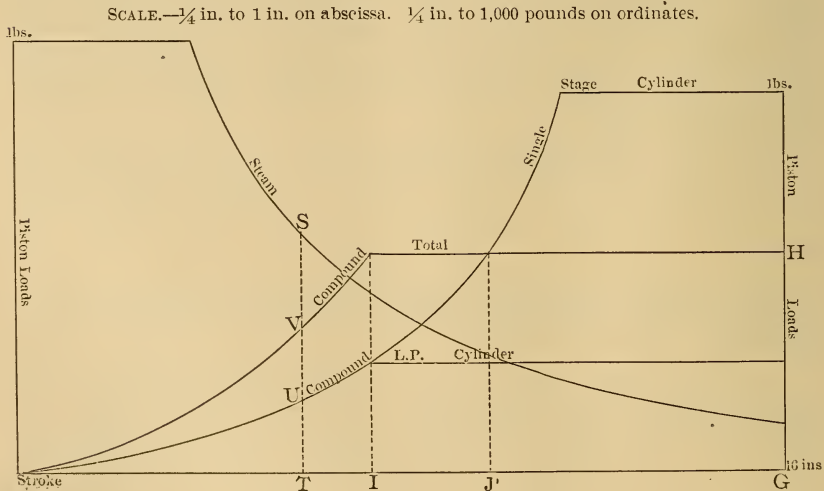


FIG. 2.

These cards, which are theoretical, do not show the variations of pressure, but the effective loads on the piston rod, either of the single-stage air cylinder or of the tandem-compound set of air cylinders, or of the single steam cylinder, and they will serve for the comparison of two direct acting steam compressors, one of them in the single stage and the other in the compound system.

As we know, these cards show a less aggregate piston load in compound set than in the single air cylinder, and as the initial loads are the same the range of variation is less in the compound, hence already a reduction in the size of the piston rods, and also of the crank pin and connecting rod. But it will be noticed that the compound curve has a sharper rise, since the maximum load HG is reached at the point I of the stroke, whilst in the single cylinder this same load is only reached at the point J^1 .

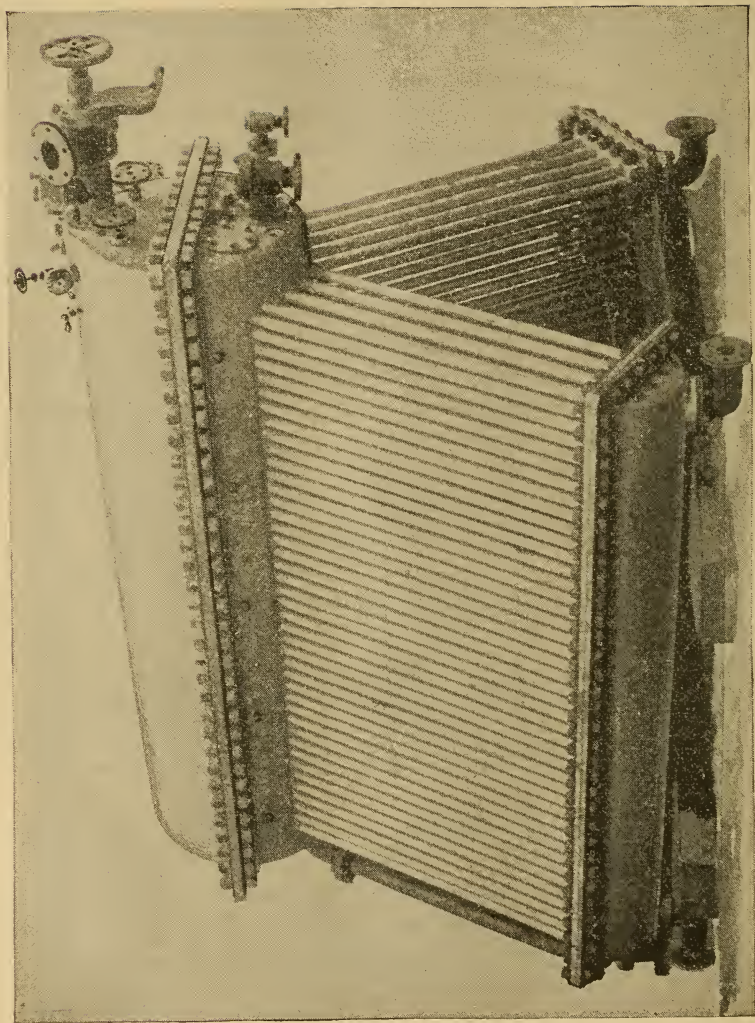
The result of it is that during this portion of the stroke, which precedes the points of equal loads in the two compressors, that is to say, the point of intersection of the steam and air curves, the difference between the loads on the steam and air pistons is smaller in the compound, where it is $S'V$, than in the single-cylinder compressor, where at the same point, T of the stroke, the difference is $S'U$.

The same may be said for the second portion of the stroke, except in the region IJ^1 , but here the discrepancy is unimportant, the piston loads being but little at variance in the two compressors, and this region corresponding precisely to the maximum velocity of the pistons. As the mass of moving pieces, whose momentum is resorted to for securing a regular motion, is a direct function of the actual difference between the loads on the steam and air pistons, we see that lighter pieces will be required in the compound than in the single compressor.

It might be observed that the work absorbed in compression being less in the compound, a smaller steam cylinder should be used; actual practice shows, however, that the same size of steam cylinder is adopted for a given dimension of the L. P. compound or of the single air cylinder, the point of cut-off being, of course, variable.

A longer expansion of steam, combined with a less weight of machinery, concur in winning for the compound compressor the deserved claim of being a better balanced and more economical machine than the single-stage compressor.

The determination of the size of the intercooler in various cases, the influence of the valve areas and of the arrangement of the



WATER-TUBE STEAM BOILER.—YARROW & CO., LONDON.

cylinders upon its proportions, the computation of the amount of cooling water, and a study of the positive valve motion, are as many subjects of practical interest which should be dealt with in a complete investigation of the compound compression, but whose treatment would extend the size of this paper beyond reasonable limits.

The above developments will, it is hoped, suffice to show that the economical production and utilization of compressed air are governed by very precise rules, and favored by such an array of practical advantages that its extensive use as a means of transmitting motive power seems to present itself foremost amongst the prospects of a near future.



THE "HORNET."

THE YARROW WATER-TUBE STEAM BOILERS.

Mr. Horace See, Engineer and Naval Architect, of No. 1 Broadway, New York, the agent in this country, sends us the plate on the opposite page, representing one of the new water boilers made by Messrs. Yarrow, of London, employed in some of the new vessels called "torpedo-boat destroyers," among them the celebrated *Hornet* represented in the plate above.

This vessel, which is claimed as the swiftest ever produced to this time, has been driven at the rate of 28 knots an hour, equal to

32.2 land miles, consequently at a higher speed than the train service on our trans-continental railways. This vessel has been sufficiently noticed in the technical press, and our present purpose is to call attention to the boilers, which are the main element in producing such enormous speeds at sea.

These boilers, as may be seen, consist of two concave flat-top water chambers at the bottom, and a parted cylindrical shell at the top, joined by straight tubes extending diagonally to the water chambers at the bottom, the whole being separable by means of bolted joints, as shown, so that every part of the boiler is accessible, inside and out.

The weight of the boilers in the *Hornet* was 43 tons, and the indicated horse power 4,000, or about 24 pounds of boiler weight to each horse power, and would not be thought possible from inference, as the boilers do not seem light in construction.

The *Havock*, of which so much was said some months ago, which is nearly the same as the *Hornet* in dimensions and character, is fitted with locomotive boilers, but did not exceed 3,500 horse power, which, as Mr. See remarks, is in direct proportion to the cubes of the speeds of the two vessels, but the air pressure in the furnace room of the *Havock* was 3 inches to $1\frac{1}{2}$ inches in the *Hornet*, double as much.

The general results thus summarized indicate a considerable advantage in favor of the water-tube boilers if the heating surface was the same, a fact not contained in the data sent. We are glad to publish the drawing because it contains a large amount of suggestions at this time in respect to arrangement. The type is in several important respects distinct from other modifications, and with certain structural advantages that will be apparent to our readers.

The mean speed of the *Hornet* in her trials was 27.62 knots, the engines going at a rate of 385 to 395 revolutions per minute, driving propellers 76 inches in diameter, steam pressure 170 pounds per inch, vacuum 26 inches. The tubes are of copper and the shells are of steel, the flanges being made integral with the plates, and carefully faced for the bolted joints.

In answer to an inquiry we made respecting the time required to open and re-make the bolted joints, Mr. See cited us to a remark of Mr. Yarrow, at the last meeting of the Institute of Naval Architects, stating this could be done, or had been done, in 40 minutes.

The main problems in steam engineering at this time relate to generating apparatus, and the trend is certainly toward a water

chamber below, a steam chamber at the top, connected by inclined water tubes that receive the greatest heat. These will be characteristics of the ultimate boiler no doubt, especially for marine service, if the setting or furnaces can be made in a manner to avoid loss by radiation and not occupy too much room.

SYSTEMS OF PIECE WORK.

No. II.

In suggesting a system of contract work in American machine works, it would be much more agreeable to explain as far as possible practical methods without discussing impediments, but as these naturally come up the first thing, and are indeed the main thing, they cannot be passed over here. We have studied them for many years, and always come first to the matter of profits, which does not seem to have any direct bearing at all, but is in fact the main impediment of all.

It is the custom, as most of our readers know, to assess profits on labor, that is, estimate labor high enough to cover profits. It is a convenient method, and it may be said that it makes no difference how or where profit is assessed or computed, it must in the end come up with the accounts as a complement to material, labor and expense; but there is this difference: profit when merged with labor or the wages account is uncertain and contingent, or as we may say, speculative, because if wages are not definite, and a matter of contract, neither can profit be certain, nor known beforehand.

The present system is extremely unsettled in this respect, and may be called the "get all you can" one; is the same indeed as workmen employ in respect to wages. It is workman against employer, and employer against his customers, ending commonly in loss to all concerned, when compared to a system of coöperation instead of one of mingled interests, each striving for a larger share of the proceeds. A fixed scale of profits prevents this.

Another impediment to be overcome in introducing contract work is the paternal or patronizing idea such as commonly lies at the bottom of profit-sharing schemes. Skilled workmen at this day, especially in what are called the engineering trades, may receive and be thankful for all that is directly connected with and affects their

work : meeting rooms, washing and bath rooms, clean well-warmed shops, good tools, light and conveniences. These are in a sense aids to constructive processes, and an admission of intelligent wants, but whatever reaches beyond this into social or private affairs breeds resentment.

In this latter category come holidays, excursions, dinners, presents, and a host of like acts, including profit sharing, that always do harm instead of good. When in England some years ago, a friend who had made good returns on a season's business, felt so grateful that he gave his workmen a holiday and dinner in the country, that cost about \$500. The men all attended ; fine speeches were made, toasts drank, and the next week the men struck for higher wages and other concessions.

The owner was amazed. " Why, those ungrateful fellows," said he, " have just been treated in the kindest manner, and now strike !" We ventured the remark that this " kindness " was the main cause of the strike. He studied the matter some minutes and answered, " I think you are right, and I will never attempt the like again," and he never has.

If instead of a dinner and excursion, he had said to his men : " My profits have been liberal, and as much has depended on your part, the labor, I am willing to add to the facilities and conveniences in the works, so you can earn more wages, or I will turn over to the division clerks the sum of \$500 to be paid out pro rata on the time cards of the last quarter, or year," there would have been no strike. If the men wanted a holiday they would have arranged that in their own way, with " earned " money, or money they considered as earned by contract.

It is extremely difficult to define acts that are patronizing and those that are not. Workmen themselves are unable to make the distinction in words, but they " feel " it, and while resentment may for a time be overcome by the spirit of kindness, it is sure to arise in the end.

Now our contention is that all time-labor involves unavoidably this patronizing relation between employer and employed. The system is about half way between owned and independent labor, or between slavery and piece work. The term " slavery " is used in a modified sense, because there is no other to define involuntary servitude. " Good to his men," is a term often heard both in respect to owners and managers, and it is correct as applied to a great deal that is so described, but " goodness " is not what is wanted. Just-

ness is the term that should express the relation. This term implies or admits an equality of interests, and is much easier determined by common standards than "goodness," which is a flexible term, and not a flattering one unless confined to acts of charity outside of and independent of a works, or as we may say, working relations.

The writer has on many occasions acted as an arbitrator in labor disputes, both where the time system existed and where the work was contracted, and perhaps no other circumstance can so well illustrate the difference of the relations between employer and employed in the two cases. Under the time system the men had to be appealed to on the grounds of expediency and self interest. There was no way of contending for justice because there were no grounds on which to base such a consideration. The men could not, under such a system, know whether their labor was given under fair terms or not. They worked a certain length of time for a stipulated amount of money, but whether the money was earned or more than earned, there was no way of deciding. Their aim was to get all they could exact, on the supposition and feeling that they had no moral responsibility beyond furnishing the use of their heads and hands for a certain number of hours each day.

It was a kind of bargain with but one determinable side; but very different were the circumstances with contract work. There were two determinable sides in the case, and justice was the gauge set up in disputes concerning wages or rates, which, however, seldom come up as a point of dispute. If casting, planing, turning, boring, drilling and erecting were done at the general rate, and well done, then the men had performed their part. If a rate was to be changed, it was understood to be in respect to future work not then estimated for, and the change was argued on the grounds of improved facilities, current prices, the volume of trade, or previous mistakes, time consumed, and so on.

Disputes in contract shops are commonly in respect to mistakes, spoiled or broken work, and accidents. Sometimes in respect to apprentice and half-skilled service, and the like, but in all cases much easier to deal with than when service is paid for by time.

Labor unions, as now organized and conducted in this country, are an insuperable impediment to the contract system. One may well admire on ethical grounds, rules that demand for every man the same wages. It is perhaps fair to concede that the men themselves, in all the skilled trades, are the best judges of what is to their interests and what rules are fair and admissible under the circumstances,

but uniform wages are illogical and unjust. It is not proposed to discuss labor unions or trade unions. The subject is too extensive to be included here, but some phases of it must be noticed as bearing indirectly upon the contract system.

In the first place, a trade union aims at the main principle of the contract system, which is independent action of the workmen; that is, the aim is to make themselves independent of their employers by organization, and in a sense put the whole roll of members on "contract" work; but there is only one side to the system. There are no regulations binding men to perform an equivalent amount of work for the wages they receive. That is taken for granted, and may not be true, indeed, is not true in many cases, but there is no standard for a day's work in most trades, hence there is nothing to appeal to. For this employers are to blame as much or more than workmen, because they have the opportunities for determining rates by records and in various ways not available to workmen. Nevertheless, it is easy to see that the main object is independent action and individuality, the same as contract work creates, but, as before said, regardless of the "other side." It is true workmen may say that where artificial prices exist by reason of a tariff on imports, or competition is shut off by combinations among employers, increased wages can be passed on to the consumers, and not interfere with the profits of an employer, and this is no doubt a reason of the communistic nature of strikes in this country, where wages are not a fixed quantity, that is, with a limit that is apparent. Why not raise them to any degree? is the train of reasoning followed by workmen, and what is a logical answer to this? There is no logical answer, unless the products of labor have to be sold in competition with other countries in the neutral markets of the world, at prices beyond an employer's control, and for which he is not responsible.

CATCHMENT RESERVOIRS IN CALIFORNIA.

Mr. William Fisher, of Calistoga, Cal., has collected at considerable expense some valuable experience in respect to water catchment for supplying that town. Some years ago he constructed in the bed of a small mountain stream a box or cistern about twelve feet square and six feet deep, into which he led his service pipe. This cistern or pool was covered over with strong planks at or below the bed of the stream which flowed over the top, and caused no

damage during freshets. This work is now perfect and uninjured after twelve years of service, and the redwood timber shows no sign of decay.

Wanting to extend his system of water supply he called in advice from engineers and other skilled people, and was informed that his method was crude and unusual, and that an impounding dam was what he required. His own opinion was that an extension of the old method, that is, a tank or penstock sunk beneath the bed of the stream was best, but he yielded to science, and built a dam at a cost of about \$15,000, going down to bed rock, and cutting a channel there in the usual manner.

A torrent came down from the mountain, "disintegrated" the dam in "short order," as he terms it. The work was built up again of unusual thickness with hydraulic mortar, and the basin, which held ten millions of gallons, was filled; but as soon as summer came, the water "fermented" and became unpotable, and the whole was a failure for the second time. He found that when the supply and outlet were cut off, which he could do by using from the old reservoir, the water became sweet, and that the supply passing through promoted fermentation, as he calls it. This seems a refutation of all theories on the subject, and we state it here on Mr. Fisher's authority.

In despair he abandoned the whole of the new work, and built above the dam a cistern or pool 100 feet square in the bed of the stream on the same plan as his first one, covered it over with a deck or roof, and deflected the surplus water of the stream to the sides. This is a perfect success. The water remains cool and pure all the summer, and there is no danger of destruction by storm water. The evolution of this second reservoir or cistern cost Mr. Fisher from \$15,000 to \$20,000, and is dear experience to him, but may, as he remarked, be of use to others.

Summing up the matter, our inferences are, after examining Mr. Fisher's plant, that catchment pools, or reservoirs, must not be exposed to the sun, and as a basin above a dam cannot well be covered, a dam is not required, and that in such cases the best way is to sink in the bed of a stream and build a cistern or reservoir low enough so flood water can pass over the top on a strong cover or roof. This constitutes the catchment pool, and is a "spring" in every sense, especially in "good sense," but it is not a common method among engineers, so far as we are aware. "Spoiled water" is one of the principal difficulties in this climate, especially in inland places, and this is avoided in the plans described above.

HYDRAULIC HOISTING PLANT.

[Frontispiece.]

The Pelton Water Wheel Company of this City have recently furnished a very complete double-hoisting plant for the Milwaukee Mine in Idaho, illustrated in the drawing above noted.

The drums are for flat ropes, winding at present 400 feet, with a load of 5,500 pounds this height in one minute, representing about 100 horse power. The motive power consists of Pelton water wheels, 60 inches diameter, under a head of 850 feet, or a pressure of more than 350 pounds per inch. This requires massive fittings, and wheel discs of solid steel, to withstand a velocity of nearly 1,000 feet per second at the periphery.

The winding gearing is of the most improved form, corresponding to the best practice on this Coast, and is especially convenient to control, all operating levers and valve gear being within reach from the attendant's platform, seen in front. The water wheel valves are operated by hydraulic cylinders, and the lowering brakes by treadles.

The principal point, aside from the extreme simplicity of the machinery shown, is the slight cost of maintenance and operating expense. When a plant of this kind is once erected and set at work, the charges per ton for hoisting are in comparison with steam power, almost eliminated, and in many cases will enable the successful working of mines otherwise unprofitable.

The Pelton Water Wheel Company find their peculiar system of wheels extending all the time in new industries and to new purposes, and the necessity of economy in these times has led to a wider use of water power, and to an increased business in water wheels, and connected work of one kind and another.

CALIFORNIA ANTIQUITIES.

A country or people not fifty years old is hardly a place to search for antiquities, in the common sense of that term, but nevertheless there are antiquities of a kind in California.

When in the town of Napa recently, Mr. George N. Cornwell of that place, who settled there in 1846, showed us some old relics of interest, among them a store house he built in 1848 from timber that

cost 50 cents per foot, board measure. The boards were sawed at the Bodega mills, the location of which is not now remembered, the price being \$400 per thousand feet. The cost of hauling to Sonoma was \$80 per thousand, and the water freight from Sonoma landing to Napa brought the price up to \$500 per thousand feet.

The store house, which was 18×24 feet, one story, of rough boards, is yet standing and in use. The total cost was \$6,400. Carpenters' wages were then \$20 a day, and a "poor day at that," as Mr. Cornwell expressed it, so this item added a good deal to the investment.

Near by is Mr. Cornwell's old residence, the cost of which must have reached an enormous sum. The building was made in Norway complete for erecting, and carried here by vessel from Europe, "around the Horn." It is ingeniously and well made, on the panel system, the corners everywhere being reinforced by flat angle irons screwed on. Even the sash and doors are thus fitted. This was in the gold-excitement period, that will furnish for ages to come the strangest aberration of prices the world has ever seen.

Everything was not dear in those times. The Bay at San Francisco was full of ships abandoned by their crews, who made their way to the gold fields. Mr. Cornwell, on one of his trips to this City, bought a full-rigged ship for \$900, and after some effort navigated the vessel up the Napa River to his place of business. There was no canvas in the country then, much needed for miners' tents, so the sails of the ship were cut up into tents and sold for more than the entire vessel had cost. The hull, as may be imagined, provided valuable room for storing, and after twenty years this vessel was again taken out to sea, refitted and put into service as a "whaler."

A rough-boarded, unceiled house, 18×24 feet, for \$6,400 and a full-rigged ship for \$900 is, we think, the greatest anomaly in prices that can be found in the history of any country, and has left its impression on business here down to the present time. It is seen in the vagaries of business profits. A slow, regular increment year by year is hardly ever thought of.

California being the home of a low class of aboriginies has no remains of interest in quality, but they are plentiful in quantity, consisting mainly in the debris of camps, where piles of clam shells, ten and even twenty feet in depth attest the long periods of occupancy. Later than this, and of more interest, are the Spanish works, yet in preservation in many places, but the main relics are those of "49."

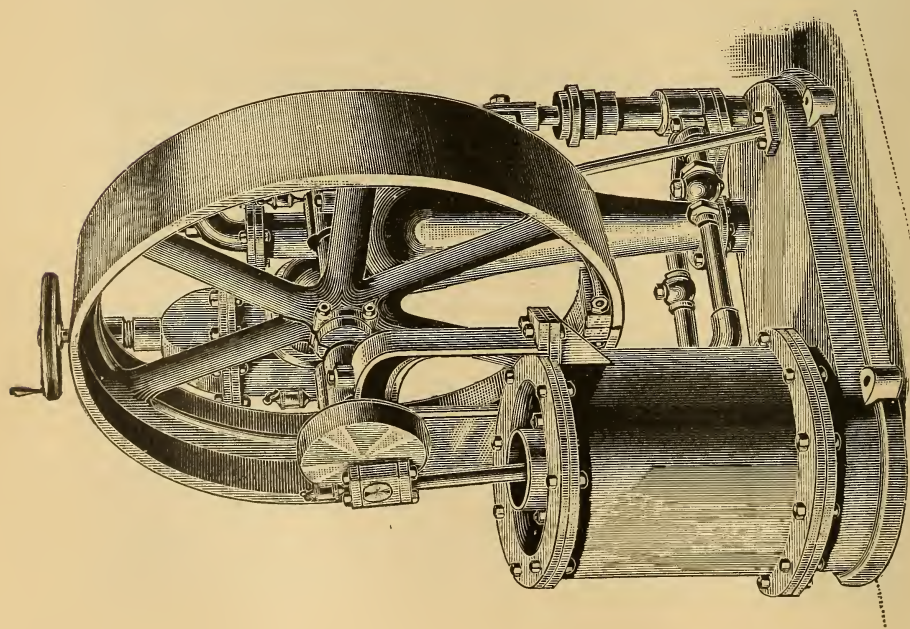


Fig. 1.

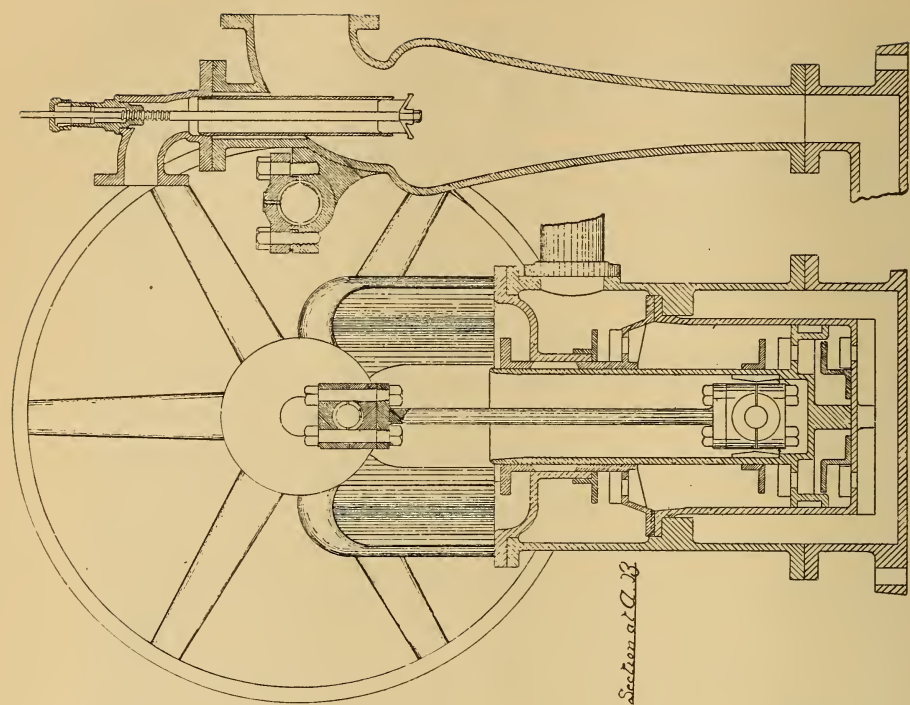


Fig. 2.

INDEPENDENT CONDENSING APPARATUS.

BYRON JACKSON, SAN FRANCISCO.

In our last issue we described land-reclaiming and irrigating machinery, illustrative of recent practice on this Coast, but had not space at the time to include the condensing apparatus employed with the pumping engines then described.

Figures 1 and 2, on the opposite page, showing an elevation and section, supply this omission. The air pump, condenser and boiler supply pump are all mounted on a base plate, and self contained, the pumps being driven by a band from the main engine shaft. The air pump gland is provided with water to prevent leaking. The arrangement of valves, and indeed the whole is of complete and efficient design, is so well shown in the drawing as to not require description.

This condensing outfit is made for engines from 30 to 200 horse power, the air pumps being from 9 to 20 inches bore, and other parts in proportion, the cost is from \$10 to \$15 per horse power, the larger sizes being the cheapest.

LAND TAX IN NEW ZEALAND.

We have several times during two years past presented such information as came to hand respecting the new system of taxation in New Zealand, but nothing of a specific nature has been available in a condensed form until a recent report from U. S. Consul J. D. Connelly, sent to the State Department in January last, and from which the following excerpt is taken :

"In the matter of taxation laws New Zealand excels as compared with the other Australian Colonies, and perhaps with many older countries. Here, at least, legislation has been introduced that has been most violently assailed as being experimental, socialistic, confiscatory and impracticable. But, regardless of this terrible arraignment, the taxation laws have been fully and successfully established and given practical effect, even while other countries were theorizing on the same principles.

In a very short time the incidence of taxation has been almost entirely changed—always a most hazardous undertaking, because of its tendency to disturb existing values and disarrange business enterprise. Here reforms have been introduced which revolutionized the old system without affecting, at least to any

appreciable extent, existing interests. It is true there were many who, through the public press, in the halls of legislation, and on the highways and byways of the country, proclaimed their belief that the changes in the incidence of taxation would surely involve the country in financial ruin, but subsequent events conclusively demonstrated how ill founded were their apprehensions. The most determined opposition to the "new taxation" came from the moneyed institutions, loan companies, and the owners of vast landed estates. It was found, however, as soon as the new system became law and was thoroughly established and fully understood, that instead of involving the colony in ruin it had exactly the contrary effect. The credit of the colony in London (which is, of course, the center of financial operations so far as the colonies are concerned) increased to an unprecedented degree. New Zealand's credit is better today on the London money market than is that of any other colony of Australasia. This pleasant position is not attributal to the new system of taxation alone, although it may be fairly said to have materially assisted in establishing confidence in the country. The non-borrowing policy of the government and the general recuperative powers of the colony assisted in restoring faith in the country.

The aim of the new government has been to relieve the "weaklings" as much as possible from the burden of taxation, and to place it upon the shoulders of those who were better able to bear it.

Up to 1891 a land and personal-property tax was imposed, but during the years of depression the colonists generally complained of the personal-property tax as being a grievous burden. One of the first acts of the new government was to abolish the "property tax," and substitute an "improvement tax." All improvements on land up to \$15,000 were exempt, but all improvements above that amount were taxed.

The deduction of mortgages and of improvements up to a value of \$15,000 renders very many owners exempt from land tax, the total number of land-tax payers in 1891 being 12,557 out of a total of 91,501 owners of land in the colony. It will be borne in mind that there is an exemption of \$2,500, so that no man pays any taxes for State purposes until his property is worth over the above amount. The special exemption just referred to reduces the number of taxpayers. An owner whose land and mortgages, after the deduction of mortgages owing by him, and of improvements up to the value of \$15,000, do not exceed \$7,500 is allowed a deduction by way of exemption of \$2,500 (already mentioned), and this amount gradually diminishes until it disappears altogether, when an owner's assessed value, less reductions, reaches \$12,500.

In addition to the ordinary land tax a graduated tax is levied, and for this all improvements are deducted; but an owner is not allowed to make any deductions for mortgages owing by him, and he has not to include in his return any mortgages owing to him. This tax is not imposed on any owner the value of whose land, less

the improvements thereon, does not exceed \$25,000, and the lowest rate imposed is one eighth of a penny in the pound. The rate gradually rises until it reaches 2*d.* in the pound on the improved value of lands up to \$1,050,000 or more. * * *

THE TECHNICAL SOCIETY OF THE PACIFIC COAST.

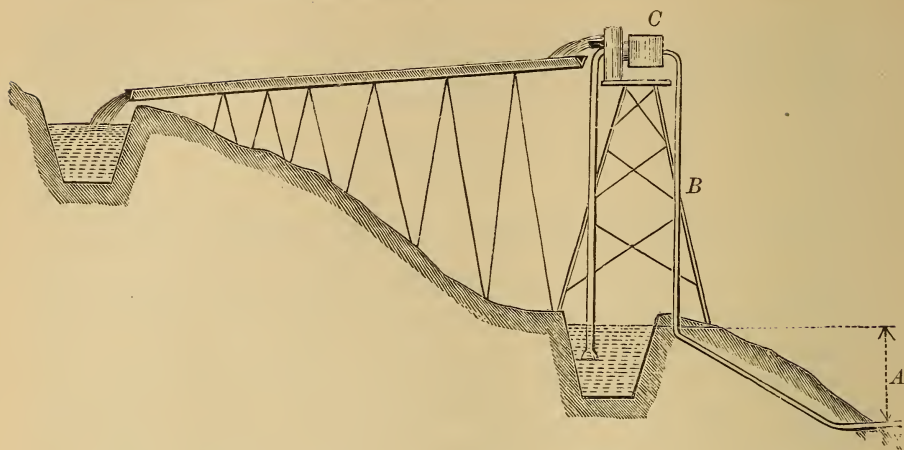
This Association held their regular meeting in this City on the 4th of May, at which time the committee appointed to consider the matter of holding a "technical congress" under the auspices of the Society in June next, made a report that resulted in a resolution to continue the committee, recognizing, however, that it was quite impossible in the time at command to secure the required papers on various topics contemplated in the scheme of such a congress in June.

Col. Geo. H. Mendell, of the U. S. Army Engineer Corps, presented before the Society, in a carefully written paper, the facts observed in the construction of the concrete work recently erected at Fort Point, in this City. The value of this paper rests upon a careful and exact observance of various results in mixing the concrete, also in the fact that with all the writings and copious dissertations on this subject, engineers seem to be proceeding tentatively, with wide divergence in the proportions and treatment. On this point Col. Mendell remarks in one place :

"The varieties in forms and sizes of materials are so great, and personal equations are so different, that rules as to quantities to result from combinations of materials in different proportions cannot be made precise. Each person is apt to find the rules derived from his own experience to differ from those established by others. Measurements of materials vary with the manner of making them. The writer has chosen to make all measurements loose, that is, the vessels are not shaken to settle the materials to a smaller volume."

It is to be regretted, and perhaps not to be expected, that Col. Mendell did not supplement his paper with some views of his own on cement or concrete construction in general as compared with ashler and brick work.

At the next regular meeting, June 1st, Mr. G. W. Sherywood will present a paper on the Nicaragua Canal, based upon his experience in connection with that work.



THE SIPHON WATER ELEVATOR.

MESSRS. LEMICHEL & O., PARIS.

Mr. L. N. Bruner, the agent for the United States, has an exhibit at the Fair in Golden Gate Park of a water-elevating apparatus that has attracted a good deal of attention, and should do so. It is the invention of Messrs. Lemichel & Co., of Paris, and seems to have a near relation to the hydraulic ram of Montgolfier, with a siphon pipe instead of a driving head. This far an explanation seems simple enough, but does not "fit" the phenomena of the machine's action.

We have on more than one occasion called attention to an obscure operation in hydraulic rams, called sometimes "regurgitation," a rhythmic oscillation, so to speak, that calls for an element of elasticity not present in the water or the ram itself, unexplained and inexplicable on any known theory or hypothesis. The present machine intensifies this mystery. No one can suppose that a column of water twenty feet long can be set in motion and stopped one hundred and eighty times in a minute, as seems to be the case.

The diagram above shows the apparatus raising water from a ditch to a higher one, the largest vertical pipe being the impulse and supply one, the smaller and longer pipe *B* on the right, the driving or "pulling one," and *A* the driving head. The impelling or power pipe it may be called, *B*, is connected to a small drum *C*, seen at the right on the top, having elastic heads that permit a kind of intermittent respiratory action corresponding to the beats of the delivery valve, while the down flow is constant. This we con-

ceive to be the case, because of the frequency of the impulses or strokes. For the rest there is an interrupting valve in the left-hand chamber at the top, closing like that of a hydraulic ram, and an escape or delivery valve above, both having soft faces and nearly silent in action.

The whole is a kind of paradox, but removed from that category by the fact that there are more than a thousand of the machines in actual use.

The efficiency attained, that is, the amount of water raised and discharged, taken as the height of delivery and the difference between the supply and discharge levels, is claimed to be 70 to 80 per cent., and inference certainly points to such a result. There is no shock or violent action, and the machine seems to be more efficient than a hydraulic ram, with the difference that it is a suction one that will raise its supply water. This latter feature removes the apparatus from the ram class, and admits of a wide use in draining from wells and ditches where a ram could not be employed, and is deserving of attention in this water-raising country.

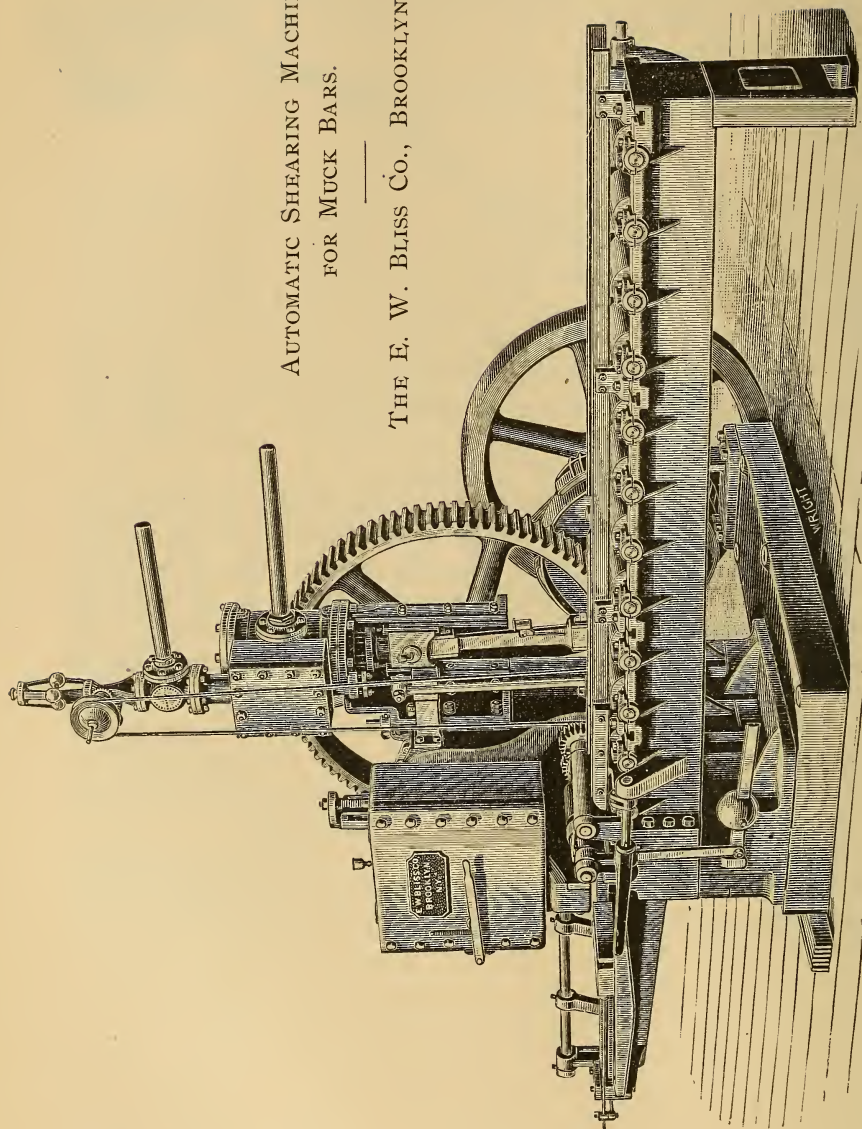
The present machine, the hydraulic ram, the steam injector and turbine water wheels are all French inventions of anomalous nature, indicating not only ingenious research, but an analysis of fluid action beyond what any other people have achieved, representing not only physical discovery of the highest class but entering directly into the useful arts over the whole world, and to an extent almost beyond computation.

This application of a siphoning column of water as an agent of impulsion may not reach the importance of the ram, the turbine or the injector, but for anything now seen it will most likely find a permanent place in a very important class of implements.

We have suggested to Mr. Bruner that an analysis of the action in this apparatus before the Technical Society of the Pacific Coast would be a matter of great interest, and this, we trust will be done while he remains here.

AUTOMATIC SHEARING MACHINE
FOR MUCK BARS.

THE E. W. BLISS CO., BROOKLYN, N. Y.



AUTOMATIC SHEARING MACHINE FOR MUCK BARS.

THE E. W. BLISS CO., BROOKLYN, NEW YORK.

In the process of rolling steel into thin sheets it would be impracticable to roll each sheet separately, as it would not retain its heat, and the following method is adopted :

A billet of steel of sufficient size to make a large number of sheets is heated and passed a number of times through a train of rolls, each pass lengthening the bar and reducing its size. It leaves these rolls in the form of a bar twenty or thirty feet long, and something like an inch thick by eight inches wide, these dimensions depending upon the size and gauge of the sheets to be made.

These bars, technically known as muck bars, are cut up into uniform lengths, and each piece is then repeatedly re-rolled and folded over, and passed through double, quadruple and so on, the metal not being hot enough to weld or adhere together, each operation reducing the thickness and increasing the linear dimensions, and each folding doubling the number of sheets in the final pack. After the last rolling the ends of the pack are sheared, leaving each sheet free to be separated.

It is very important that the pieces into which the muck bar is divided should be of uniform size and squarely cut, as upon this depends the size and form of the subsequent pack, and it will easily be seen that any error will be largely exaggerated with the successive passes through the rolls.

The method heretofore employed for shearing the muck bar has been to carry the bar to the old-fashioned alligator shear, place the end against a fixed gauge, which determined the length of the pieces, and pass the bar along by hand for the successive cuts. This method not only requires the labor of several men to handle the bar, but calls for considerable skill on the part of the shear man, and unless great care is used the results are liable to be unsatisfactory.

The illustration represents a machine by the E. W. Bliss Co. for doing this work automatically, thus requiring but one unskilled man to do the work.

The machine consists of a powerful gate shear driven directly by an engine. A clutch is attached to the engine shaft, which can be operated either by hand or automatically. To the right of the machine is a carrier composed of a train of rolls driven continuously. The muck bar, coming hot from the rolls, is placed upon these car-

riers, which propel it toward the cutters between side gauges, which keep it in position at right angles to the shear blades. Just before entering between the cutters a pair of feed rolls take hold of the bar so as to feed it positively.

The forward feed of the bar is controllable by hand, so ragged or first ends can be cut off, after which it moves forward against the gauging devices seen on the left. This engages a clutch that sends the shear knife down, cutting off uniform lengths continually until the whole bar is reduced to "lengths."

The machine is driven by a steam engine, forming an integral part of the structure so it can be set anywhere in a rolling mill. There are a number of these machines in use that have led to a considerable saving, being rapid in operation and dispensing with skilled attendants.

GAS MOTORS FOR STREET RAILWAYS.

To other excerpts from the Reports of American Consuls, for April in this year, we will add one on the subject of "Gas Motors for Street Railways in Germany," by Consul-General F. H. Mason, at Frankfort, and will remark that Consul-General Mason is happily possessed of technical knowledge that has been of great value in describing and commenting upon industrial subjects of various kinds. We much regret that our space does not permit a full reprint of the communication, but the following comprehends the main facts :

"The problem, from the German standpoint, has been to devise a motor which shall render each passenger car independent, one which, during days or hours of increased travel, can draw one or more additional cars, which can be run upon rails laid at a considerable grade without overhead wires or any subterranean construction ; a car which can be started and stopped quickly and surely by one man, which can be supplied in any required number during the busy hours of the day, and when not in use can be run into and left without consuming or wasting anything, ready for immediate service when needed ; a car that shall run silently, without hissing steam or defiling smoke, and which shall be withal not too costly in construction or too complicated to be handled and kept in order by an average mechanic. These requirements, in the opinion of many experts, narrow the choice down to two forms of motive power, coal gas and compressed air. The use of compressed air for such purposes is perhaps still in its infancy, but its advantages are frankly conceded. It is clean and quiet, it causes

no smell or unpleasant heat, and the car is under perfect control and is wholly independent of wires or other connections along the line. But in Berne, where air compressed by water power under highly advantageous conditions has been used, it is found that at a pressure of 32 atmospheres 4.2 cubic meters of air are required to produce one horse power, or about 150 cubic feet per horse power per hour. Each car carries twelve reservoirs, with an aggregate capacity of 2,170 cubic feet, which can be filled from the main reservoir in eight minutes. Thus provided the car, which at Berne weighs when empty 7 tons, can run 12 miles, but at an expense of 15 cents per car-mile, which exceeds the cost of horse power. On certain lines which lead through luxurious suburbs, where travel is heavy and high fares may be charged, compressed air may be recognized as the ideal motive power of the future. But since it is found that in Berne, with all of its advantages of compression by water power, the cost of operation exceeds that of horse cars, the chances would seem to be against its general adoption for ordinary city and suburban lines.

A careful study of the whole subject has led to the adoption in two notable instances of cars propelled by gas engines. These practical trials have been made at Neufchatel, in Switzerland, and at Dresden, and the results in both cases, although not yet perhaps wholly conclusive, have been so favorable that they seem to be worthy of examination. The conditions to be met in Neufchatel and at Dresden were somewhat different, but they are substantially similar to those which exist in many of the smaller cities of the United States.

At Neufchatel there was required a new line $3\frac{1}{3}$ miles in length to connect that city with the village of St. Blaise. Nine tenths of the distance lies outside of the city limits, and through a district which could furnish but few passengers. The estimates had to be made on a basis of one car either way every half hour during fourteen hours of daily service, with an average of seven passengers per car, each paying 5.7 cents for the through outward or return trip. The contract for the equipment was let to a firm in Vevey, which undertook and fulfilled the task of providing motor cars to be driven by gas engines supplied with ordinary illuminating gas from the city mains. These cars are strong and practical in construction, they run quietly, without jar or smoke, stop and start quickly, and the machinery requires to be cleaned but once a week. Each motor car carries 20 inside passengers, and weighs, when filled, about 6 tons. They cost, delivered at Neufchatel, \$2,856 each. These cars can pass curves of 100 feet radius, run backwards or forwards with equal facility, and with 7.9 horse power are able to traverse any part of the line, which is 40 feet higher at the midway point than at either terminus, at a speed of 11 miles per hour. Gas compressed to 6 atmospheres is furnished by the city gas company at \$1.09 per thousand cubic feet, and it is found that under such conditions the cost of gas per car for the round trip, $6\frac{1}{2}$ miles, is 19.3 cents, or

about one cent per passenger for the single run from Neufchatel to St. Blaise or return. This brings the net operating expense per passenger so far below the cost of electricity, horse power, steam or compressed air that, although the experiment is still new, the problem is thought to be solved in favor of gas for all roads of a similar class.

But by far the most elaborate and interesting experiment is that which has been made at Dresden, where a street railway about 3 miles in length is operated with gas-motor cars invented by a German engineer named Lührrig, and built by a company at that place, the engines themselves being supplied by the well-known Gas-Motor Fabrik at Deutz. This system has been in operation for several months, and has been the subject of careful study and investigation by committees and experts from other municipalities, which have in contemplation enterprises of a similar nature. Among others the city of Nordhausen sent a commission headed by a government railway engineer to examine and report on the working of the new system, and the report of this committee, while recognizing that there remain some minor difficulties yet to be overcome, declares the system a practical success and recommends its adoption at Nordhausen. At Dessau another line to be similarly built and equipped is now under construction, and will be put in operation during the coming summer. Germany has therefore definitely started toward the adoption of gas-motor cars for a certain class of roads, and the experiment has reached a stage at which it deserves the attention of practical engineers in other countries.

The Lührrig motor car is built to accommodate sixteen passengers seated within, with standing room for five besides the motor man on the front platform, and six on the rear platform. Passengers are not allowed in Germany to stand in the aisles of street cars holding to straps. Under the American system of crowding and packing, one of the Lührrig cars would carry perhaps forty people. Power is supplied by two double cylinder gas engines of 7 horse power each, located on either side beneath the seat and carefully inclosed in zinc sheathing, which excludes gas and smells and protects the machinery from dust or contact. Under the frame work of the car are located at each end four cylindrical reservoirs, the whole eight having an aggregate capacity of about 360 cubic feet of gas, sufficient to run the car 11 miles over a road in which the grades do not exceed 1 in 20. The car weighs, without passengers, $7\frac{1}{2}$ tons, and can be made for from \$3,500 to \$4,000, according to the number included in one contract. The cylinders of the engine are kept cool by water circulating through pipes leading from a cylindrical reservoir carried on the roof of the car, the heated water rising and the cold descending automatically, and with such satisfactory results that after a run of several miles the warmth of the cylinders may easily be borne by the naked hand.

Gas is supplied from the ordinary street mains, and is compressed to 8 atmospheres by a simple double-barreled force pump

worked by a stationary gas engine or other power, and at this pressure the reservoirs of a car may be filled through a flexible pipe in less than a minute. Gas costs in Dresden \$1.05 per thousand feet, and in view of the advantage which such a wholesale all-the-year-around consumption would offer to gas companies it is safely assumed that most of them will be willing to erect compressing machinery at their own cost, and deliver the gas to the motors at the prescribed density. The car is managed by one motor man standing on the front platform, who, with throttle and governor, regulates the speed at will from 150 to 240 engine revolutions per minute. As the double engine gives a motive force of 14 horse power, a second car may be attached whenever needed, thus doubling the capacity of the line during the hours or days of greatest activity. A loaded car climbs a grade of 1 in 15 at a speed of 4 miles per hour, but for satisfactory work in all weathers and seasons the grades should not exceed 1 in 20.

In an address delivered before the German Gas and Water-Supply Association some weeks ago, Chief Engineer Kemper, of Dessau, submitted a comparative estimate for the construction and equipment with gas motor, electrical and horse cars of a street railway 5 miles in length and requiring an outfit of twenty cars for ordinary service. In these estimates double tracks for all, two compressing stations at \$2,500 each, sheds, etc., for the gas motor cars are included; for the electrical roads, dynamos and overhead wires, and for the horse cars 120 to 150 animals with the requisite stabling and fixtures, the intention being to show the comparative cost of building and putting in operation the same road under each of the three systems. The exhibit is as follows:

Electrical	\$180,880
Gas Motor.....	142,800
Horse Cars.....	133,280

The original construction and equipment account is therefore slightly in favor of horse cars as compared with gas motors, though both are notably cheaper than the electric plant. But this difference in favor of horse power rapidly disappears when the cost of daily operation is taken into account. As the result of careful study, Mr. Kemper states the net operating expense of horse cars in Germany at $5\frac{1}{2}$ to 7 cents per car kilometer, against 5 cents for electric cars, and 4 cents for gas-motor cars of the Lührig model per car kilometer. There is thus claimed an economy in motive power of 25 per cent. in favor of gas as compared with electricity, and from 60 to 75 per cent. in comparison with horse power."

EXTRACTS FROM A NOTE-BOOK.

BY "TECHNO"

No. XXII.

ON A DOMESTIC TOUR.—KNICKERBOCKER DUTCH.—THE MEMBER
FROM CHATAHOOGA.—AMERICAN RAILWAY CARRIAGES.
THE GENESSEE.

————— The transition, or translation it may be called, from the college to the shop, is the goal to which every student's aims and aspirations tend. The monotony of study, embracing extraneous things, and the play of the laboratory, are like the training at a barracks before an army goes to the front. Everything one learns or does has reference to this change, and the sulphurous smells, grime, and noise of the shop become pleasant odors, ecstasy and music, for a time at least.

I have had a little of both, and like both ; the college because it is done with, and the shop because its labors and self-denial are congenial ; but there is a surfeit of all things, and a new trip with my Uncle is an agreeable respite, well earned too, by hard work, a strained spine, sundry bumps, nips and contusions of manual and pedal members, so that a letter from New York, "giving instructions," was welcome and more.

My Uncle, in his usual didactic style, says :

"Will start from here next week — don't know which way, and it don't matter ; will keep to the water as a medium of transportation as much as possible. One is always cramped and disappointed by set plans for a journey. These belong to construction : bring a two-foot rule ; a short glass (ocular) ; some stout, rough clothes, and if not an infliction, leave that everlasting note-book at home."

The above constitutes the "introduction" account here, down to the Albany boat, a cool seat to windward, and a short lecture on the Dutch, growing out of the name "Hoboken" seen on the western side at starting.

"The Dutch," said my Uncle, "were at first exasperated, then amused, and finally pleased by the raillery of Washington Irving in his 'Knickerbocker' History of New York. Stolidity and smoke, both of them are good in their place, and the former, if we call it conservatism, is not a quality confined to the Dutch. Here abeam of where we sit is a steam engine driving this boat, quite as antiquated now as a Dutchman's breeches, sharp gables, and galliots were a century ago.

I am not complaining of a plain beam engine, on its merits, so much as of its incongruity in modern practice. No Dutchman ever stuck to his long pipe with more tenacity than the Americans have to these low-pressure single-cylinder steamboat engines. The fact of their being knocked out at sea, in one round, fifty years ago, did not have any effect, and while we may admire the ingenuity and skill that has maintained the beam engine on American boats down to the present time, we must not forget that the same skill and energy, if it had been applied in other lines, as it now must be, might have set us ahead instead of behind the rest of the world.

“High pressure, wide expansion, and machinery under decks is the rule, or will be. On the St. Lawrence, from Montreal to Quebec, they have beam-engine boats, but the structure is of iron, under the roof, and otherwise a gainly improvement on the type we have here.”

This was a kind of revolutionary change of opinion for my Uncle, but he was right. Beam engines *had* many virtues, but their time is past.

—The Hudson is a grand river, wanting only in “lineal dimensions,” as my Uncle calls it. “If this country,” said he, “had any concerted and practical ideas except how to get office—had any patriotism not confounded with the Treasury Department, the Hudson would long ago have reached from Albany to Buffalo, or to Lake Ontario, or both. Steamboats should go from Duluth to New York, and will sometime, when we have ten thousand less legislators, and the member from Chatahooga is not obliged to use his energies in securing an appropriation for the improvement of Catahoola Creek, so a scow can get up to his town and bring out the potato crop. What is a trans-country waterway to him, whose interests lie at Chatahooga? What has he to do with Lakes Superior, Michigan, and Erie? He don’t live there; besides, who can blame the member? He has not a neighbor or supporter who is not acting on the same principle, and cares as little for National matters, or any matter not in their own environment.

“There are a thousand objections to a centralized government, and nine hundred and ninety-nine in favor of it. These quantities being varied from one side to the other by the character of the people, or rather the prevalent sentiment in a community. Put it into an equation, and add to the popular government side, virtue and honesty, the other factor becomes minus, and is destroyed. Put there instead general selfishness and ignorance, and the popular government side is zero.

"We are getting into a position where National undertakings, or National anything, is impossible, except as political bargaining. There is very little National property of any kind, except for military purposes, but there is private property with National attributes. You see that train there on the shore; that is private property, also the way and the land beneath it. So its owners will tell you, at least. Yet the company, or those who own the road, have or may exercise what our legal friends call 'eminent domain,' that is, condemn and take private property, at an appraisement, for their own use. There is not a court in the land that will not at once say that eminent domain can be exercised for public purposes only. How then is a railway private property? I am speaking of National matters and the chances of a canal from the Lakes to tide water. That the Government can make such a canal, or one across the Isthmus of Darien, who doubts? Make them honestly and cheap, but where will the member from Chatahooga, and his friends, 'come in'? That is the problem."

Waterways or canals are an old theme with my Uncle. One who has spent their life mainly on this element look upon railways as upstart affairs, good enough for dry land and internal or home traffic, but only supplementary in the commerce of the world. It is probable, when we come to think of it, and when the power of government again reverts to the people, there will be a good deal more done in the way of water transport than there is now.

—If old Hendrick Hudson came up here in the summer it must have delighted his senses to have looked out upon a scene like the one now before us. It was just the same two hundred years ago. The little trimming and cutting done by human hands has not much changed things, and never will. What has taken the mighty forces of nature millions of years to work out cannot be much affected by man's puny powers in a century or two. Just over there a great charge of dynamite knocked off at one time a hundred thousand tons from the rocks, and the result is scarcely visible—a mere speck.

The Hudson is done; no great changes will come in future, at least in the estuary portion, and that means nearly all, because when it becomes a veritable river, at Albany and Troy, it is not much of a stream, a country river, so to speak, and only a drainway with rapids, pools, and even cataracts; its principal function being to drive saw and paper mills, and the like.

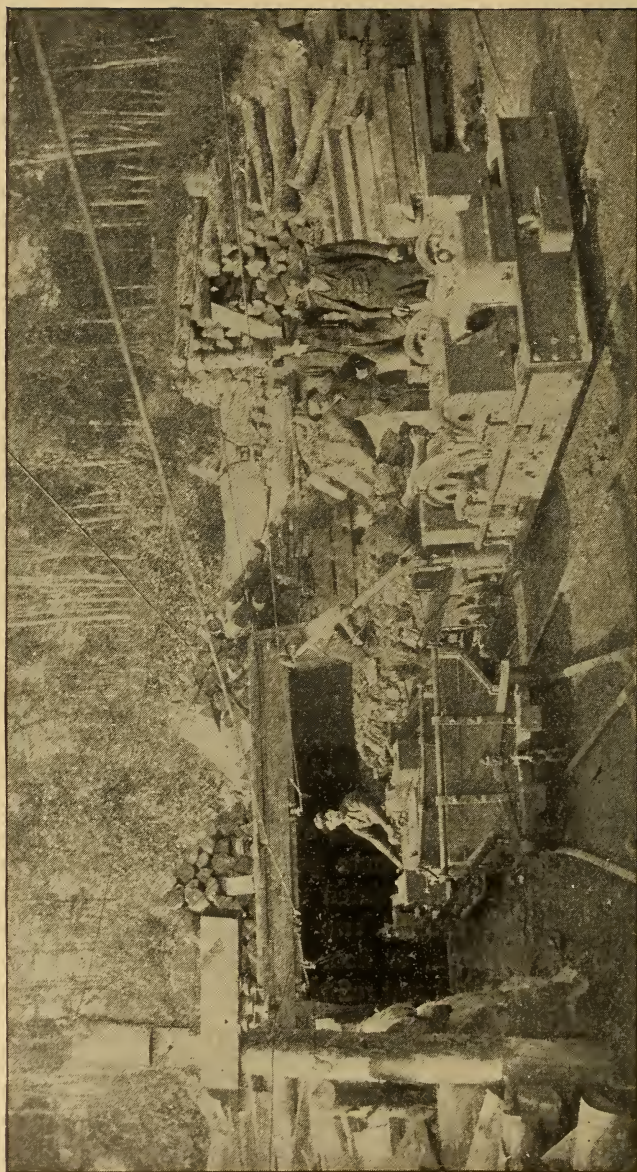
At Albany we took the train across the country, and across the best portion of it I have seen, to Buffalo. My Uncle, in searching for a place to stow his effects, became "cloudy," and I could see in his manner portent of a dissertation on railway methods. I knew he was no admirer of the very exceptional system in this country, and after we had crowded into a seat with about fifteen inches of room for each, he began :

"Here," said he, "is a great box with cubic space enough in it to accommodate everyone, and not a place to stow your hat, even. People seated jam together, packed like sardines, half of them strangers in pairs; somebody just behind you looking down your shirt collar, and exhaling their breath around your head for second use in your own lungs, and then to be passed on to the next person. Twenty per cent. of the length of this train is made up with platforms and stairs to get up to the platform from the ground, and then one narrow door for both entrance and exit. These platforms belong in the stations, not on the cars. What's the use of carrying tons of them with the train when they had just as well be in the stations? It is all an adaptation, and awkward; saves the company from the expense of providing platforms at the stations. It is the idea of the old road wagon continued, and this is why the doors are in the ends of the cars.

"When traffic is dense, as it was at Chicago during the exposition there, they were compelled to abandon this system and fit up their trains and stations as is done in other countries. Just wait until we reach a station and then watch the result of this platform method."

I did so, and at Rochester saw all and more than my Uncle had claimed. A hundred or more persons wanted to get out, and another hundred or more wanted to get in. The forces met and chaos reigned. It required two and a half minutes to get from our seat to the platform, or floor of the station. The whole train could have been emptied and refilled at Chicago or on any European railway in thirty seconds.

I am not quite patriotic enough to consider this a sensible system because it exists here. Time will change it, also will produce compartment cars, or those without a gangway down the center to accommodate peanut venders; also will eliminate the commercial agent we call a "conductor," who comes around underway and causes you to hunt up and present a ticket as often as he chooses, generally every time the train stops at a principal station. If some



ELECTRIC HAULAGE AT THE BEAR RIVER MINES.—BLOSSBURG COAL CO., LANDRUS, PA.

one gets on he must be hunted up among the other passengers to collect the fare. Once it seemed right, now it seems crude and awkward.

—————Here at Rochester, the Genessee River tumbles over a cliff, and as my Uncle says, "becomes romantic." This, he informs me, caused the selection of this place for a city, because of the water power available, now employed for various manufacturing uses, especially grinding grain.

(To be Continued.)

ELECTRIC MINE LOCOMOTIVES.

THE GENERAL ELECTRIC CO.

992
In the plate opposite is shown the mouth of a Pennsylvania coal mine, in Tioga County, Pa., where electric locomotives, made by the General Electric Company, are exclusively employed for haulage. The scene is "coal minish," and true to nature.

The makers send the following particulars of these locomotives :

"The locomotives, of which there are two, are of the 'two-motor mining' type, each of 30 horse power. They are propelled by two thirty horse power motors, one being geared to each axle. Current is brought to the motors by a specially-designed trolley arm, on which the trolley wheel is swivelled to permit of its adjustment to the various irregularities of the wire line. The trolley arm can be set in sockets on either side of the locomotives, which can be run into headings on either side of the main haulage way, which is lighted by incandescent lamps placed at the entrance to each cross-heading, 100 yards apart.

These locomotives are arranged to run at a speed of 6 miles an hour, with a draught power of 1,500 pounds. The gauge is 36 inches; wheel base, 30 inches; diameter of wheels, 28 inches; width over all, 48 inches; length over all, 9 feet 6 inches; height above rail, 31 inches; weight 7,500 pounds. The current is furnished by a 75 horse power generator furnished by the General Electric Co., driven by a Harrisburg Ideal 80 horse power engine. The maximum load which these locomotives have been called upon to draw is 32 loaded mine wagons, each weighing 3,200 pounds, and the way is at one place on a grade of 3 per cent. The daily haulage of the locomotives is about 650 tons.

The entire plant has been eminently satisfactory in use, the locomotives having shown capabilities beyond the specification or the Company's guarantee. Their presence in the mine has done away with the slow-going mule, and induced great economy. The small elevation above the rail level permits the locomotive to enter places where it is impossible to employ mules, and the ease of control and operation is such as to astonish those in charge."

ELECTRIC LOCOMOTIVES.

In a recent letter from Mr. Charles Brown, formerly of Sulzer Bros., Winterthur, Switzerland, now of Basle, one of the most eminent mechanical engineers now living, he speaks hopefully, or even in a sanguine manner, of the great electric locomotive on the Western Railway, of France. We quote as follows from his letter :

“For the last twenty years I have been more or less engaged in the construction of locomotives, and with considerable success. More lately I have gone in for electric traction, believing that a great future is in reserve for this application of electricity. My last production in this line is the large electric locomotive running experimentally on the Western Railway, of France. The success of this machine, its absolute smoothness of running, which has for a consequence an immense saving in the wear and tear of the road and the vehicle, and greater safety in running, so that it is perfectly practical with this class of locomotives to work trains safely at much higher speeds than usual. This construction, moreover, furnishes the means of building engines of a power far beyond anything hitherto attempted, as I hope soon to be able to show by two new engines, which I am engaged on at this time.”

We have spoken disparagingly of this locomotive and the system, but if it emanates from Mr. Brown there is in the scheme something to command serious attention. He does not devote time to chimerical projects, and is not likely to ignore economics.

On this Coast, increased speed, which seems to be the object of these electric locomotives, would have no object, but an invention that would reduce the speed and retain the traffic would be one of value. Speed is a sequence and complement of “competition,” and competition is “odious,” or is becoming so in this country at least.

It is dangerous to comment upon things one does not understand, but it is hard to imagine that an electrical plant sandwiched in between a prime mover and the locomotive driving wheels is necessary. It is true this problem has been a difficult one in the case of electric motors, and indeed in all cases where the motive element has to be supported on springs, but it is certainly surmountable by more direct means than an electric generator and motor. However, as before said, no one is more able to judge of this than the eminent engineer before named, who must see some logical and sufficient way of carrying out the scheme.

A NICARAGUA CANAL SUGGESTION.

The Engineer, London, of April 13th, in speaking of the Nicaragua Canal in comparison with the partially-completed work at Panama, presents a number of new points of interest and importance. In respect to the Nicaragua route there is the following :

“But the chief trouble at Nicaragua would be political. The government offer the company a strip of land ten miles wide on either side of the canal. This piece of land would presumably be neutral territory. But at present the borders of Lake Managua form a favorite fighting ground whenever a revolution is in progress, and if armed insurgents or government troops were to be kept off this neutral zone, the Canal Company would require a small army to make its neutrality respected. Probably, also, the Nicaraguan Government would not agree to have their territory cut in two in this manner, and to be prevented from using the gun boat which they have on the lake. Till this point has been cleared up the offer of land will be of little use to the Canal Company.”

Following this is a suggestion, which certainly has a good deal to recommend it :

“Would it be to the advantage of the whole civilized world, and more particularly of England, France and the United States, that the two oceans should be connected by a canal? We do not think that anyone could give a negative reply to this question. Then let these three nations take the matter up, and each appoint one or more engineers to study the whole subject. Let these engineers, who would of course work together, be provided by their respective governments with the means to engage a competent staff, not only to survey the lines of country proposed, but to make working drawings and accurate estimates of the work to be done on the line they select. Whether capitalists would be willing to find the money necessary to carry out the undertaking would, to a great extent, depend on the engineer's report, and whether financial help could be obtained from the governments of the nations most interested is rather out of the province of *The Engineer* to discuss. But it would be necessary that the Governments of Colombia and Nicaragua should be told that no payment must be demanded for the permission to make the canal, and that the country in which it was located would have to content itself with the indirect benefits which it would receive both during and after construction. Neither would a new company be able to devote part of its capital to purchasing the rights of the holders of Panama shares. The concession will have lapsed before the engineers could make a report, and the only benefit the present shareholders can now expect to receive is that when work is actively commenced in either country they would be able to

sell their plant at a tolerably good price. And this is no small matter; miles of tip trucks, dozen of dredgers, hundreds of locomotives and railway plant of every description, fixed engines, barges, steamboats, etc., are to be seen at the company's depot at the Boca, or scattered all along the line. Most of these are still in good order, the machinery is regularly cleaned and painted, and the quantity is ample, even if both canals were to be put in hand simultaneously."

MR. JEARUM ATKINS.

In *Cassier's Magazine*, No. 26, there is given a portrait and short biography of Mr. Atkins, by Mr. R. D. O. Smith, in which the following mention occurs:

"Somewhere about 1840 he devised a water wheel planned to absorb all the momentum of the moving stream, and he was able to demonstrate in advance the physical results which were afterward justified by experiment. But when, in 1853, he laid this invention before the Patent Office, the examiner was not able to comprehend it and it was rejected. Being then a bed-ridden man, owing to spinal injuries inflicted by a runaway horse, the application was not pursued, but twenty years afterward it was again presented with matured details of structure, and a patent was issued on August 10th, 1875. Since that time the invention has been public, but its merit has not been recognized, and the patent has expired without a wheel having been built."

In the same number of *Cassier's Magazine*, and in *INDUSTRY*, No. 67, is given a full account of Mr. Atkins' wheels, which in so far as any record appears, were the first partial or unfilled turbines reduced to a practical form.

Mr. Smith sent to the Editor recently a letter written in 1854, and reprinted below, that shows conclusively that the Atkins water wheels were reduced to successful practice at that date, forty years ago. The letter is as follows:

GENEVA, ILL., January 9th, 1854.

MR. JEARUM ATKINS:

DEAR SIR — We have put in operation in our factory one of your centrifugal water wheels, which we have constructed as nearly as possible according to the drawings which you gave us last Summer. We have now fully tested the wheel and take pleasure in testifying to its superior merits, and most cheerfully recommend it to all interested in such matters. We are confident that it is the most economical wheel in use in point of power; it is steady running, works as well in back-water as out, and is compact and strong; we

shall put in another like it this Spring. Several of our mill and machine-shop owners have determined to tear out their old wheels and use your centrifugal wheel.

Signed { GEORGE MARSHALL,
JOHN F. WHITAKER,
CALVIN D. READ.

On this letter are endorsed the names of twenty men, mill-wrights and others, who had examined and approved Atkins' wheel and confirmed the statements above made.

One may well wonder at the laws of evolution, when forty years from the time the above letter was written, and when partial or impulse water wheels were demanded at Niagara Falls, there was but one firm, and that in California, prepared to submit plans for impulse wheels to be used there, and the plans finally adopted were furnished by a Swiss firm, Messrs. Faesch & Picard, of Geneva.

Even at this time little seems to be known of water wheels of this kind, and we think it would be a wise thing if some of our makers would now take up Mr. Atkins' drawings and make wheels from them for places where filled or pressure turbines are unsuited.

Our reason for the re-mention of this matter is to say that Mr. Atkins, who is now 79 years old, an invalid, and without such means as are required to render his last days comfortable. Some of his friends are applying for his entry into the Mechanics' Home, at Philadelphia, and certainly this poor recompense for his notable services in various branches of mechanic art is more than due. It would be a graceful thing for the engineers and mechanics of California to offer some testimonial to this deserving brother in the craft, and we have the promotion of such a thing in view.

The absence of organized aid for infirm skilled men in this country is an anomaly, also is a shame.

THE EARTHENWARE INDUSTRY IN ENGLAND.

Consular Report, No 163, for April of the present year, is one of value, containing much of both interest and use to the public.

One section, by U. S. Consul Wendell C. Warner, written at Tunstall, is an exhaustive report on the subject above named, one of much interest here. Americans are much puzzled over the pottery problem. We maintain a customs tax of 50 to 65 per cent. on pottery, that is, crockery and table ware, and yet if one will, when at the table, turn the dishes over and look at the bottom, the foreign trade mark will appear in nine cases out of ten.

The economic phase of this problem we have discussed before, and do not propose to enter upon it here, but to give some of the technical facts of the manufacture from Consul Warner's report, as follows :

"In the northern part of Staffordshire, England, bordered by low hills, lies the consular district of Tunstall, commonly known as "the Potteries." It extends along a winding valley for a distance of nine miles, and is made up of a series of semi-detached towns, varying from 10,000 to 60,000 inhabitants each, the combined population being about 250,000. This chain of towns is traversed by a line of tram cars that run each way every fifteen minutes, and by a "loop line" railroad that affords transportation each way every thirty minutes. Viewed from the summit of a hill, overlooking the valley, one can see only a confused mass of oven stacks enveloped in clouds of smoke that the wind sometimes lifts, partially revealing the busy life below.

In this stretch of country are produced all classes of clay goods, from common stoneware and earthenware to the most expensive grades of the latter, also delicate China and ornamental creations of world-famed artists. The clay, worth today but a nickel, passes through the fingers of skill and genius, and tomorrow becomes an almost priceless vase. That man can so cleverly stamp his inspiration upon forms of yielding matter gives an interest to the study of the pottery art that many branches of manufacture lack. In this report, however, I do not intend to treat the subject from the standpoint of its highest art, but simply as a manufacture, confining myself wholly to the factors of capital, cost of material, labor and wages.

Before plunging into statistics, I shall give a brief account of the process of manufacturing earthenware, which is the principal product exported to the United States from this district, confining myself to those grades that find their way into the houses of the many, this report being intended for the masses who know nothing of the processes that reduce a lump of brown clay to a dinner plate. I do not intend to go into minute details, even if I were sufficiently acquainted with the business to be able to do so, but only so far as to make the remainder of my report intelligible to the general reader.

Earthenware is made from ball clay, China clay, flint and stone. Ball clay comes from Devonshire and Dorsetshire. China clay comes principally from Cornwall, in the southwest part of England, although some is obtained in Devonshire. Flint is mainly obtained from France, while Cornish stone, which is not in such a state of decomposition as China clay, comes from Cornwall. None of these materials are found in Staffordshire. Ball clay forms the foundation of the ware, flint furnishes the whitening material, Cornish clay assists in making it whiter and less liable to break under a sudden change of temperature, and a small quantity of Cornish stone renders the ware more compact and of a closer texture. Thus each and all are necessary ingredients. The grinding of each material forms

a trade of itself, though many manufacturers have mills of their own. The process is not unlike that used in polishing marble, a heavy stone fastened to a bar being made to pass over a surface paved with stone. Each material is in this manner ground with water until the mass is in a liquid state. The next stage consists in mixing the four ingredients together in such proportions as the manufacturer deems best for the purpose required, one mixture being as follows: Seventeen parts of ball clay, nine parts of China clay, five parts of flint, three parts of Cornish stone. After mixing, the liquid is run through a lawn sieve to remove every particle of dirt and then through magnets to extract the small particles of iron remaining in the mixture.

At this stage the liquid mass must be deprived of its superabundance of water, which is accomplished in this manner: Presses are made of wooden frames placed in a vertical position. When placed side by side a space is left in the middle. Each of these compartments is lined with a sheet of strong cloth folded in such a way as to form a bag. The liquid mass is then forced through the press by means of a hydraulic pump, the water filtering through the interstices of the cloth and escaping between the ribs of the frame. When the presses are taken down the solid clay is formed in the bags. It is then taken and passed through a "pug," which is a machine consisting of sharp knives on a rotary shaft, the clay coming out of this ready for the workmen to transform into various shapes.

The above description of the process of getting clay ready to work may not be the one followed in all establishments, but is substantially the method which I have seen in several manufactories. Clay is reduced into tableware by pressing (sometimes by the aid of a jigger and jolly), moulding, throwing and turning. A jigger is a potter's wheel, which consists of a round plaster head upon which the molds are placed. This is made to revolve swiftly by means of an endless rope running under the bench, driving all the jiggers in the works. To form round flat dishes, such as plates and saucers, a bat of clay is placed on the mold, and a jolly, acting as a lever, presses down upon the clay, reducing it to the shape required. Bowls and the bowl part of cups are made in molds, also revolving on the jigger, the handles of the cups being attached later. Other flat dishes, not round, and hollow-ware shapes are made in moulds by hand, the patterns for which are drawn by the designer and fashioned by the modeler.

All moulds are made from plaster of Paris, because it quickly absorbs the moisture in the clay. The making of moulds is a distinct part of the potter's business. Some are made in one piece, others in several parts. Moulds do not last long and require constant renewing.

Throwing consists in reducing a ball of clay, by means of the hands only, when placed on a jigger to a hollow mass of nearly any design, forming vases, pitchers, jugs, etc. The success depends entirely upon the skill of the workmen. By throwing the work is finished only on the inside, the outside being finished by a turner

when the article is partially dried. This is accomplished in a manner similar to turning a piece of wood. Handles are made by pressing the clay in a mould, and attaching to the cup or pitcher when both parts are sufficiently dried to keep their shapes when handled.

When clay is formed into the requisite articles by any of these methods it is placed in the drying room, usually called the greenhouse. When the ware is sufficiently dried the next step consists in 'firing' it. A person unaccustomed to pottery terms will better understand this process if it is called 'baking.' The first firing, or baking, is in a biscuit oven. Ovens are of various sizes, shaped like a round pyramid, vaulted at the top and covered by a chimney. Some are 19 feet in diameter and 20 feet high. The ware is placed in bake pans, called 'saggars.' Saggars are made of common fire clay, which is found in abundance in Staffordshire. The making of saggars is another distinct branch of the trade. The ware placed in these receptacles is packed in sand. The saggars are arranged in the oven, one over the other in columns called 'bungs,' each sagger forming the cover to the one underneath. Around the bottom of the oven are several openings in which fires are built. These flues join at the center. The firing is conducted at first slowly, then gradually raised to the proper temperature. The process requires great care and experience. It lasts from 40 to 60 hours.

When removed from the oven, if the ware is to remain 'plain white' it is ready for glazing, but if it is to be decorated with a printed pattern then that process follows. The designs seen on all kinds of printed ware are first engraved on copper plates. From these plates the pattern is transferred to the dish by means of thin tissue paper sized with soap, first being placed on the copper plates that have been rubbed with the color mixture, and then pressed tightly to the ware. When the paper has been removed by flinging the biscuit ware into water, the whole of the color remains on the dish. The ware must then be brought to a red heat to burn the oil mixed with the color. This is accomplished in the 'hardening-on kiln.' The next step is to glaze the ware. The preparation of the glaze is a delicate process, and attended with serious consequences. It must not be too fusible or too hard, else the ware will dull or craze. The ware may not craze in weeks or years, but if the glaze mixture is not perfect and not in touch with the biscuit ware it will happen sometime. Glaze is made of borax, flint, lead and stone, each ground with water to the consistency of cream and mixed. The proportions in the mixture are determined by each manufacturer, and are trade secrets. After dipping in the glaze and drying, the ware is taken to the glost oven for the next firing. It is again placed in saggars, but this time without sand, and so that no two pieces touch. This firing takes about 20 hours. When removed from the oven it is ready for the warehouse.

In this process, briefly described, it will be seen that greater skill can be attained, and the cost of production lowered, by having each workman perform a distinct operation. This is always done, so that in pottery language men are referred to as 'jiggers,' 'flat pressers,' 'cup makers,' 'printers,' 'oven men,' etc."

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Consular Reports.

ADVANCE SHEETS, APRIL, 1894.

At St. Etienne, in France, one factory mentioned by U. S. Consul Whiley, the looms are driven by dynamos, and there is with each an accumulator that absorbs the excess of current if the loom is stopped but an instant, and thus avoids waste of current. The power is generated by steam in this case.

U. S. Consul Chancellor, writing from Havre, in February, sends the following:

"The following is Maestracci's method of manufacturing petroleum bricks for fuel:

Mix one liter of petroleum, 150 grams trituated soap, 10 per cent. of resin, and 333 grams of caustic soda. Heat this mixture, being careful to stir it well meantime, until solidification commences, say about forty minutes. If the mixture should tend to boil over pour in a few more drops of the soda, and continue to stir until solidification has sufficiently progressed, then pour the semi-fluid material into moulds to form the bricks, and place these in a hot room or drying place for ten or fifteen minutes, then remove them and let them cool. In a few hours they can be used as fuel.

To the three elements which constitute the mixture Mr. Maestracci recommends the addition of 20 per cent. of sawdust, and 20 per cent. of clay or sand, which makes the bricks more solid and less expensive. Trials of these bricks as fuel have been made at Marseilles on several tugs, and it has been found that, weight for weight, they develop three times as much heat as the ordinary coal brick, and leave no ashes."

As the value of the ingredients are not given it is difficult to determine the economic value of a fuel so prepared. The calorific value is only one side of the equation.

Consul Wendell C. Warner sends from Tunstall, England, a very elaborate report on the pottery business in that district, and furnishes a good many items of interest.

The wages paid in the better class of work are liberal, and, as we think, quite as much as are paid in this country for similar kinds of work when the value of things are compared. For example, dish makers get from

\$6 to \$10 per week; "jiggers" get from \$8 to \$11; cups and saucers, made by women and boys, is a cheaper line of work, the wages being \$5 to \$8, but living expenses are less than here.

The Consul says: "Near all pottery works good five-room houses with cellar and a small back yard can be rented at 85 cents to \$1.00 a week," and by going out some distance rents are less.

A significant remark follows: "The English Government is largely supported by a tax on wealth, and the work people are practically exempt." A workman pays indirect or customs taxes on tea and coffee, and we may say on nothing else. Guns, carriages, privileges, coronets, checks and the like, which workmen do not have, are heavily taxed.

In this connection it will be proper to point out that it took a long time to learn the British people the incidence of taxation; it is a difficult kind of education. Three fourths of the people do not understand indirect taxation. They will pay away a third of their earnings throughout the year in customs taxes, and imagine they have paid no tax at all.

Progress in Flying Machines.

B. O. CHANUTE, C. .

This octavo volume of more than 300 pages, containing over 100 drawings of aeronautic apparatus, has been published by the *American Engineer and Railroad Journal*, of New York, and will, no doubt, meet with a welcome acceptance and wide sale among the large number of people who are interested in the problem of human flight.

Aside from the scientific phase of the subject, here treated in *extenso* for the first time, there is an unusual interest in this problem. We see around us a wide species of animal life that rise and soar through the air by muscular effort on principles and in a manner that has baffled all attempts at successful imitation. The phenomena is continually before our eyes, inducing a longing for like powers, and calling out all the

resources of contrivers, costing millions of money and a vast amount of wasted effort.

It is therefore with much satisfaction that one learns that an engineer of eminence in his profession has set at work in an unprejudiced manner to examine into the nature and history of flying machines, and to analyze, classify and explain the various apparatus that has been produced. It is a by-way of science, a path trodden almost alone by the "contriver." The author, with the publisher, also an intensely practical engineer, have placed the world under an obligation by this unusual literature.

The compilation of facts consumed many years. Some of our readers will remember the visit of the author to this Coast some years ago, and his inquiries here respecting aerial apparatus. It is within the province of this notice to point out the enormous amount of wealth and effort that this work will save to the world by preventing useless experiment, and directing effort in proper channels.

It would be a pleasure, even a duty, if our space permitted, to follow through the orderly and exhaustive technology of the work, every page of which is thus worthy, but many, if not most of our readers are already familiar with Mr. Chanute's writings on aeronautics in Mr. Forney's journal the *American Engineer and Railroad Journal*, since 1891, also his first volume on the subject of "Aerial Navigation," treating of balloons and cognate matter.

The warrant for such research of an engineer is found in the increment of power in proportion to the weight of motive apparatus, and the possibility, or even probability now, that such apparatus may in the near future raise its own and considerable added weight in the atmosphere.

The volume contains an account of the Maxim experiments, and in an appendix a translation of Otto Lilienthal's experiments, the latter a very interesting account that describes the most successful attempts at human soaring made to this time.

The book can be ordered from the publishers of the *American Engineer*, 47 Cedar Street, New York.

The Secretary's Manual.

This little work of 220 pages, by Mr. W. A. Carney, with the imprint "Santa Paula, California," sent in by the Bancroft-Whitney Co., of this City, is one of the most useful books we have seen for a long time.

Its purpose is to instruct secretaries of incorporations in the multifarious duties that pertain to this office, as regulated by statute, by-laws and custom. It is admirably arranged, perspicuous in method, complete in its scope, evidently prepared with a full experience in and knowledge of all legal decisions affecting the operation of corporate bodies, also their nature, power and conduct.

A secretary is commonly the executive officer of small incorporations. His duties are continuous and frequently embrace the whole conduct of affairs between the intervals of directors' meetings. For a chairman or presiding officer a parliamentary manual may answer, but a secretary must have much more, and in this book will be found instructions for all that is necessary or apt to arise in the discharge of his duty. Price \$1.50.

Transactions of the American Institute of Electrical Engineers.

VOL. X, 1893.

[Published by the Institute, New York.]

We can do little more than acknowledge the courtesy of the publishers in sending this publication. The contents are technical and voluminous, covering proceedings characterized by a high professional standard.

The papers presented at the ten meetings held during the year indicate an advanced position of the membership in the intricate art to which their energies are directed. The membership includes 768 members, of which there are but 17 in California.

The offices for the year were as follows: President, Prof. Edwin J. Houston; Secretary, Ralph W. Pope; Treasurer, George McPhelps. The Society have rooms at 12 West Thirty-first St., New York.

LOCAL NOTES.

A hurried trip during the "still" period to the Machinery Hall at the Midwinter Fair discloses a good deal unexpected. The display is creditable, and more, while the arrangement reflects much credit on Engineer Hunt, who had a chaotic problem to deal with. The same remark applies to Engineer Hasson, who, besides the electric generating plants, that absorb nearly the whole power of the engines exhibited, had a fearfully complicated problem of distribution to arrange. We propose at a later time to examine and say something of the exhibits, especially steam engines, from local makers. The display of Messrs. W. T. Garrett & Co., and of the Dow Steam Pump Company are especially noteworthy, extensive and in good taste, also conserve useful purposes. The educational effect of the industrial sections will be a principal good. Of the "show" part, it will be a concession to call it necessary.

It is rather strained criticism to complain of the highly creditable display of machinery at the Midwinter Fair on the grounds of "paint," but one must confess to disgust in seeing well-made machinery covered with glistening paint and varnish, showing every pin hole and dentation of surface in the castings. The chromatic part too is execrable with but few exceptions. Think of cast iron being painted with red ochre and varnished! Also in some cases with white lead ground in oil, relieved only by grease stains and landscape work on panels. It has long been conventional with makers of good machinery to paint it with lusterless paint of a color called steel, and as near to that of cast iron as possible. This causes the castings to look smooth, harmonizes with finished parts, and permits accurate photographing. We think that Manager Hunt should send for a barrel of "machine" paint, and insist on the exhibitors covering over the present ornamented and glistening surfaces.

Further, in respect to painting machinery, steel-colored lusterless paint and "filling," which is the same thing in a stiff paste, has by common consent become a sign of good taste and good work. Many years ago Messrs. William Sellers & Co., at Philadelphia,

made experiments to determine how their machines could be properly photographed. All reflection had to be avoided. That was obvious, so the machines were lime-washed with different tints, which succeeded, but was a good deal of trouble because the wash had to be removed and substituted with paint. Mr. Tully, a paint maker in Philadelphia, took up the matter, and after a long train of experiments produced a lusterless paint that resisted animal oils, and with a good pigment lasted for years without change of shade. It also became as hard as iron and was applied to castings as soon as cleaned and before working them. The works in Philadelphia adopted this paint for machinery, and it has spread a good deal but not so much as one could wish on this Coast.

The State Populist Convention, at Sacramento, has nominated candidates for the various offices with "names" that sound well, if nothing more. There was, by newspaper reports, an omission of whiskey and beer, also of methods that are commonly called "political," which may also be defined as despicable. We are among those who have no fear of Populists, as such, and not as the "tools" of other parties. They may make mistakes, probably will, but the country can endure a good many mistakes, and at the same time carry a large balance to the credit side of the public ledger. If the industrial interests are affected by this new party the same as in New Zealand, we can stand a great deal of it just now, especially on this Coast. We have noticed in the past that "ruined" manufacturing interests thrive wonderfully, like Powers & Weichtman's sulphate of quinine factory, at Philadelphia, which was closed a dozen years ago, because the duty was taken off this medicine, but started up again directly and has flourished better than ever since that time.

Mr. Jas. A. Maguire, the agent in this City, has sent in an example of the wired glass made at Philadelphia. It seems a novel and very useful manufacture, consisting of a woven web of wire imbedded in the center of the panes or plates of glass, giving an ornamental appearance. The main objects are to avoid fracture and the scattering of glass in case fracture should take place, because no part can fall away or come out, even if a plate is broken to pieces. There is at Tacony, above Philadelphia, on the Delaware River, a large manufacture of this material that has several times been

extended, and from numerous letters from skilled men who have these wired plates in use there is no doubt of its serviceability. It is employed for both rough and ground plates, and can be applied in any case where there is risk of fracture. This wired glass has been used in a large number of the principal buildings in this City, and extensively in government buildings at various places. The Pennsylvania Company used over 100,000 square feet in their new station at Philadelphia.

Two companies, one at Ogden and one at Salt Lake, are now "exploiting," as the French call it, great water-power plants for light, power, and other manufacturing purposes in these cities. By other manufacturing is meant the electrolytic reduction of salt, of which there is a superabundance thereabout, as everyone knows. Mr. C. K. Bannister, the engineer of the Ogden scheme, has recently visited this City, and explains that instead of long wire transmission, that company proposes to bring the water to the city under a head of 380 feet, the terminal conduit being a steel pipe of six feet in diameter. The Salt Lake scheme is similar in nature, with 14 miles of transmission from Cottonwood Cañon, also by a pipe line, as we understand, but of smaller size, 4 feet 6 inches in diameter. Either of these cities, or any city indeed, is vastly advanced by such a power and light system at reasonable cost to consumers.

The wreck of the Pacific and Home Savings Banks, in this City, is an illustration of the very reckless methods that exist in business here. The history of the origin, rise and connection of the people who founded and managed these banks, to say nothing of the methods on which they were conducted, should have been a sign and token of swindling. Responsible banks do not advertise their business, and we will undertake to affirm that no bank that has pursued such a method has succeeded. When Bowles Bros. established a bank in London, and issued letters of credit to hundreds of Americans travelling in Europe, a business man we discussed the matter with in London said: "These men will fail; an advertising bank always fails." They did fail absolutely, and left people stranded, without funds, all over Europe. The extraordinary exposure now made in respect to the "vinegar-bitters" banks must convince people of the utter inutility of a "State Bank Commission," and to some extent of all commissions. "Government by commission" is a failure.

The *Engineer*, London, seems to have "kicked over the traces," and abandoned the ethics of the profession. In the issue of April 6th there is a bare-faced "write up" of Messrs. John and Henry Gwynne, makers of centrifugal pumping machinery, at Hammer-smith, a most notable business certainly, but the circumstance is none the less a departure. In the next issue of April 13th there is a portrait and personal notice of Mr. Thos. Parker, a successful locomotive superintendent. We infer that Mr. Parker is yet living, and active in his profession, and if so, one can hardly think that he, as a member of the Institute of Civil Engineers, would consent to have such a notice and illustration of himself. We do not wish to draw invidious comparisons with a leading technical journal of the world, but can assure our readers that neither of these articles could have found a place in *INDUSTRY*. Such matter is unfair toward the trades who pay for advertising space, and are necessarily devoid of general interest or use.

Mr. A. E. Chodzko, who, last month, contributed the article on "Mediums of Transmission," continues in this month's issue on the subject of "Compound Air Compressors," a subject that he has given special attention to. He is a graduate of the School of Mines, Paris, and is familiar with the remarkable system of air transmission in that city. His contention is that, taking into account the physical conditions of this City and its industrial circumstances, there is a peculiarly favorable chance for air distribution to operate elevators, engines and for all purposes requiring motive power. From frequent conversations with Mr. Chodzko on this subject we think that a plant of the kind here would be a permanent and profitable investment without risk, and would meet with immediate patronage.

The American people have lost a man they can ill afford to spare at this time. Gen. Matthew M. Trumbull, of Illinois. At this day and certainly in the near future there will be work for men like Gen. Trumbull to do in curbing and controlling the spirit of unrest and disorder in the land. Gen. Trumbull was a Republican in politics, but a constant and vigorous opponent of "protection" in all its guises. Some of our readers will remember our notice of his last work in book form, "The Free Trade Struggle in England." His voice, his pen and his hands were always active in the cause of liberty and progress. He served with distinction in the Mexican War and

the Civil War, rising to the rank of Brigadier-General, and his death was due to causes growing out of a severe wound received at the battle of Shiloh. One man like Gen. Trumbull that rises above his selfish interests and contends for broad humanity is as a thousand who are incapable of such thought and aspiration. May his life and its lessons be a mark for emulation.

COMMENTS.

Socialism, Populism, Greenbackism, Silverism and Coxeyism are all the result of thirty years of Government "Paternalism." The Industrial Army is simply practicing the iniquity it has been taught, and is going to Washington in the belief that Acts of Congress can make work, increase prices, create money and values. They are acting in good faith in the doctrine that on their votes and the "powers of Government" depend the material interests of the country. Then why not go to Washington and at the fountain head set things right? Some time, let us hope not too long in the future, it will be learned that the laws of Congress have about as much effect on values as the commands of King Kanute had on the waters of the Atlantic Ocean, when he ordered the waves back from his royal feet, but such laws do have a great effect upon "people," implanting in their minds false ideas of their relation to the Government.

The French Government, after it emerged from a bloody revolution, undertook a paternal scheme of providing work for people, among the rest, tailors. A Government building was given rent free, capital was furnished, and the tailors were set at work making army uniforms that had cost eleven francs by contract. This price was to be given to the men, dividing also the excess gained under the Government plan; but the uniforms came out at sixteen francs each, instead of eleven. The scheme of paternal relief was grand in conception, 125,000 men were enrolled in Paris alone. The National workshops absorbed one half the population. National bankruptcy soon came in view, and as one writer remarked, "12,000 men were killed to restore order and sanity." This was less than fifty years ago, yet with this history in their faces modern politicians, to gain votes, or, in their ignorance, disseminate these same socialistic doctrines in this country.

The Antwerp Exhibition is now "on," so to speak, and another many millions of dollars will be spent in a manner strangely inconsistent with the economical state of the times. We are among those who believe the Chicago drain of a hundred millions or more of money spent without tangible return has a good deal to do with hard times in this country, not only by the spending of this much money, but in the derangement of affairs caused by the temporary shifting of a great volume of labor. We have attended a number of these world exhibitions, and must confess to but little appreciable gain as a visitor and intend in future to confine attention to such as "come to hand." The strongest reason for such shows is found in a human propensity for such things, found among all people and nations of the earth, from the savage upward. The carnivals of Italy, races in England, and Mardigras in New Orleans, are born of the same spirit. It may be good, and even necessary. Who knows?

Mr. Cramp, of Philadelphia, says the Fithian Free Ship Bill would stop the work of 6,000 men in his works, and as many more depending upon him for material of one kind or another. We remember reading something like this before, very like it, indeed, from speeches and circulars published in England about forty years ago. The whole ship-building industry if thrown open to the world would be destroyed at once. Every yard would be closed the very day the Navigation Acts and duties on timber were repealed. Even the repairing would go to Holland, Denmark and elsewhere. But the Acts were passed and for some strange reason none of the yards were closed. On the contrary, the amount of work done the very first year exceeded that of any year before. The whole interest grew, and the end we need not describe. It is before us now. Ship owning and ship operating must precede and include ship building, and this with the commerce creates an interest so vast that ship building is a small matter in comparison. One does not exist without the other, and we imagine that ship building would be vastly increased by the Fithian Bill, or any other that would permit American owners to sail their ships under the flag of their own country.

The Afghans are acquiring the customs of modern civilization, and will soon require pocket-flasks and pistols, also silk hats and cigars. An English manager out in Afghanistan stated at a late

meeting of the Institution of Mechanical Engineers, London, that he had 2,500 of these swarthy people at work, making everything "from cannons to candles and from brandy to boots." The missionary too is there no doubt to teach how the consequences of transgression can be avoided, and we may soon look for a new star in the chain of civilized nations, where popular elections will be held and "bosses" set up the ticket with a view to the spoils. Unless permanent conquest of Afghanistan is intended or expected, we think a much better way to deal with that country is to let it alone until it absorbs in its own way through some centuries to come a civilization that suits them. The "Ahmeer" will no doubt be provided with lodgings in London, in a few years hence.

We received last month a courteous circular from the "Association for the Promotion of Profit Sharing," but did not publish it because we do not believe in profit sharing. Profits, such as are referred to, we contend belong to those who invest their capital in business, and do not concern labor, which is quite able to work out its own profits. The main objections to such a system are stated in another place, but objections aside, such a system is impractical in a permanent way, and need not be considered except in a few cases where the accounts of a business can be exhibited, audited and tested. The scheme is a move backward, not forward, and, however well intended the efforts of its promoters, we imagine that harm rather than good will result from any paternal effort of the kind in this country. It seems fair and logical enough for the owner to furnish the capital, the workman the labor, and divide the profits, but the profits are an uncertain quantity when figured out by the owner, and contingent not so much on the labor as on a good many other things with which the labor has nothing to do, and for which it should not be responsible.

The proposition to abolish the U. S. Coast and Geodetic Survey Office is one to which the term "cool" will well apply. The purpose is to put this work in the hands of the Geological Survey. Shades of Simon Hassler! If the old veteran were alive now, he would be more in danger of apoplexy than when General Jackson asked for his resignation in 1830. The Bureau is eighty years old, without a scandal, or so far as we know any question as to ability, pure administration and useful work. As to the Geological Survey,

we have in this part of the world abundant means of comparing methods with the older Bureau, and we think a consensus of opinion will be that the geologist part had better be placed as soon as possible under the Coast and Geodetic Survey Office. We have this old and honorable department and the Army Engineer Corps to point to as public service unstained by politics, or what this term implies. Let them be kept sacred as a refutation of Senator Ingall's "iridescent dream."

In nine principal American cities there are whole or partial owners in 567 vessels sailed under foreign flags. Of these 43 are wholly owned by Americans. Of the foreign vessels owned or chartered by American citizens there are 275 steamers, aggregating 517,321 tons, sailed under the British flag; while the whole of the registered steam vessels under the American flag is only 249, or 26 less than are sailed under the British flag by Americans. Here is a pretty comment on paternal legislation. Why should laws be maintained that compel the citizens of a country to sail under a foreign flag more vessels than are enrolled under their own National flag? It is time some other method was tried. The circumstances indicate the desire and ability of the American people to carry on ocean commerce, also that it is impossible to do so under the present Navigation Laws. San Francisco is not included in the report above.

The effectual manner in which nearly every kind of agricultural industry in California is taxed, choked and controlled by the schemes of carriers, factors and middlemen is forcibly set forth in one of the Napa, Cal., journals as follows:

"It is a well-known fact that the wine dealers of San Francisco combine each year and fix the price of wine, and there is no alternative but for the growers to accept the terms so fixed, or allow their product to remain in the cellars, which unfortunately few can afford to do. The result of this condition of affairs is that now the wine dealers are offering only *five and a half cents* a gallon to the producer, and the dealers are deriving whatever benefit is afforded to California wines by the tariff of fifty cents a gallon on the imported wines. * * * If the foreign wine could be landed at the New York custom house for nothing, the present tariff gives the wine dealers' ring a margin of $44\frac{1}{2}$ cents a gallon."

We believe that in this country alone serial journals are numbered as of a volume, and one may well ask what such a number is for. The very term indicates its intended office of showing the number of issues from the beginning, but relevancy and reason aside, of what use can a "number" be unless it indicates total issue? A serial number is at once a clear index of reference in two words to any issue of a journal, while a volume number cannot be defined in less than six or more words, and then is confusing. For example, a current issue of the Journal of the Franklin Institute is No. 5 of Vol. CXXXVII, which means there are 137 No. 5's. If instead of this the number was, as it should be, 822, then all would be clear, and any number from the first issue would be definable. Even the "volume" is confusing and unnecessary, number is all that is required.

Dr. R. W. Raymond, in the *Engineering and Mining Journal*, says: "Large numbers of men have been encouraged to believe that they have the right to do what the law forbids, and must be suppressed if liberty and order are to continue among us." He then instances 50,000 miles of railway in the hands of receivers, and the chaos that exists as the result of heretical teachings. Granting all this, we think Dr. Raymond has contributed his share in this heretical teaching, the very core of it in fact, by contending that the Government could create work and high wages by Acts of Congress. When a man is told that a Protective Tariff Act by Congress will build up industries and raise wages, that man, if he is credulous enough to believe such a thing, wants Congress to do this in some way, and goes to Washington with Coxey to "see about the matter." And as an idle class is a necessity in this country, if it is to consume its own products, the men are but following out the logic of their instructors. The 50,000 miles of railway in the hands of receivers as a result of labor disturbance requires some explanation. The connection is not quite clear.

Seven years ago when on the ground for some months in the midst of the excitement over the Manchester Canal, we, from the standpoint of an outsider, ventured the opinion that such a canal, if ever made, could not pay interest on the investment, and the first few months of its use indicates such a result. The grounds for this opinion was the amount of trade jealousy that entered into the matter,

the enormous cost of construction for the docks required at Salford and Manchester, also the inconvenience of delivering and receiving goods at these cities. The ships cannot go to the mills and the goods cannot be hauled there on wagons except to those near at hand, and when necessary to ship by railway, it would cost about the same from Manchester that it would from Liverpool. The Manchester district contains four millions of people, and comes as near forming a terminal for such a waterway as any place can, but it is not enough. Such a tremendous work as this must be a highway for nations in order to return a revenue. The shares of the canal are said to have declined over 30 per cent. since it was opened.

The *Mining and Scientific Press*, in a recent issue, contains this account of the closing of the Temescal tin mines in San Bernardino County:

“The English company became alarmed at the increased tariff on tin and tin plate, the closing down of the Welsh tin plate manufactories, resulting in millions of dollars’ loss and the discharge of thousands of workers, and the Temescal ore proving to be unusually rich, they decided to suspend operation on these mines and pocket their loss rather than ruin the English tin interest. The stockholders refused to advance any more money by voluntary contribution or mortgage bonds and the stock reverted to the bondholders.”

The idea of a patriotic English company closing down a valuable mine here because its product interfered with the interests of the Welsh mines, is wholly original. Comment is superfluous, but if the Editor of the *Mining Press* knows any one who wants to purchase the San Jacinto estate at one half of its original valuation, tin and all, we will engage that a bargain can soon be made.

There has on the whole been a rapid change of public opinion respecting the Nicaragua Canal during four months past, and there is scarcely any one who does not now believe that no quasi partnership between a private company and the Government is judicious or even admissible under any circumstances, and the wonder is that any other view ever existed. Whether any one or any combination of Congressmen can be found to promote a scheme in which there cannot exist private interests is a question. As a rule, any measure of national character finds weak interest or support under a “representative” system of government, and this we imagine will be an

impediment in the case of the Darien Canal. The plea by Mr. Davis, of Illinois, that we have no navy to defend such a canal is of no weight, and applies to any of our Coast cities and their harbors as much as to a canal at the Isthmus. It will not need defending if we observe good faith, and the "war people" do not gain enough influence to bring about such an emergency.

ENGINEERING NOTES.

Mr. J. H. Cooper, of Philadelphia, in *Locomotive Engineering*, furnishes an interesting article on cycloidal curves, those produced by a point on the periphery of a rolling disc or wheel. This curve seems to occupy a prominent place in several material functions, and has various generic properties that are interesting and curious. It is the curve of quickest descent for a rolling body. The length of a cycloidal curve is four times the diameter of a generating wheel or disc by which the curve is formed. The area enclosed by a cycloid is three times that of the generating circle. Mr. Cooper points out the functions of this curve in the form of wheel teeth, called the "epicycloidal," that all are familiar with, and how hydraulic curves, in the case of pipes, should conform to the cycloidal form. The vanes of water wheels should also have the same form, and we think a better name would be "the curve of deflection."

The great London wheel, now in the course of construction, varies a great deal from the Ferris one in design, and corresponds in general to a bicycle wheel in arrangement, the radial members being diagonal and for tension only. The wheel will be 300 feet in diameter, supported on towers 175 feet high, but these, which are a disfigurement in other structures of the kind, are converted into buildings in the London wheel, having four stories, containing restaurants and other public rooms reached by stairs and also by elevators. The axis, which was solid in the Ferris wheel, will be a tube, seven feet bore in the new wheel, and contain a passage through it from one tower to the other. A notable point of difference from the Ferris plant will be in the driving gearing, which will be by means of wire cables like the Firth wheel at the present Exhibition here, operated by electric motors of 50 horse power, which should be sufficient if there is anything near a counterpoise of the load.

All statistics involving experiments are questionable, and those relating to railways are something more. The late experiments on train resistance in American and English railways is a case in point. The grade, weight and so on showed a resistance of 6 pounds per ton for the English train at 17 miles an hour, and 3.51 pounds per ton for the American train at 19.5 miles an hour, which any one with fair knowledge of the matter will set down as nonsense, especially when as shown in the *Engineer*, London, that the energy consumed was as ten to nine in the two cases, so the question arises, what became of the surplus on the light "pull," especially when nearly double the quantity of fuel was burned? Such experiments are not easy to make without errors, and, like all the rest of the same class, resemble the Indian's gun, that "cost more than it come to."

We have receive from Mr. Charles Brown, C. E., of Basle, Switzerland, some description of the Mortier Fan, noticed also in the *Colliery Engineer* for May, 1894, which quite "upsets" preconceived notions respecting the centrifugal impulsion of air, or, as we should say, of the mechanical means employed for such impulsion, and from some facts in Mr. Brown's letter there are evidently forces and causes at work not recognized and treated in the usual formulæ. The air both enters and leaves the periphery of the wheel or impeller, and seemingly under conditions much alike in the two cases. More will be known of the system soon, and we refrain from any opinion at this time, and until some new facts are at hand. The French are wonderfully prolific in ideas of a novel nature, and have contributed more perhaps than any other nation in the way of fluid moving or impelling apparatus.

There has been a good deal said respecting the "failure" of the Cunard steamers *Campania* and *Lucania*, but when a year's work is footed up the result shows a mean speed throughout of 20.35 knots an hour for the two vessels. The *Majestic*, *Tuetonic*, *New York* and *Paris* are $1\frac{1}{4}$ knots behind this, and it is hard to see where the failure "comes in." The difference is about six per cent., and is certainly all that can be expected. We are continually being told of wonderful steamers to run at 25 to 30 knots an hour, lines to cross the Atlantic in four days, but these are not ship builders' or ship owners' stories. These people are quite aware of the conditions that permit an incre-

ment of speed. It is no matter of guess work, or is it a matter of spurt runs made over a measured course, but one of regular service for a year, and no shorter time can develop the real qualities and speed of a ship, especially in the Atlantic service, where the winters and summers are so different. The exacting demands made upon engine performance in these "liners" reach over a period of a year of trial sometimes.

Mr. M. N. Forney, in his journal, the *American Engineer*, offers a suggestion that should command attention. He proposes that the volume of water in steam boilers in respect to horse power be made a subject of discussion, and in commenting on this matter indicates views of his own that are likewise held by most practical engineers. This is the *bete noir* of the water-tube boilers, an insuperable objection to the system, the consequences of which may, however, to some extent be overcome by expedients to regulate the water supply. Mr. Howden, in his recent vigorous defense of cylindrical boilers compares the volume of water contained in a steam boiler to a flywheel for storing up power, and the analogy is good. Every practical man who has had charge of steam machinery develops a fondness for large water volume, and a dread of the opposite. It is bred in the bones, so to speak, and to see a steam gauge pointer act as an index for the revolutions of an engine makes one feel like "going out into the fresh air."

The bursting of steam pipes at sea has culminated in a catastrophe of such extent and in a place that we may now look for some change in practice. The German war steamer *Brandenburg*, while slowly steaming down the harbor from Kiel, burst one of her steam pipes, killing all the people in the engine and stoke rooms, thirty-seven in number. Only a few months before a similar catastrophe on another gunner, the *Elbe*, killed nine people. Other accidents of the kind will be remembered, and now after all this, the time has come for some effectual change. The Italian naval authorities have wound the steam pipes of some of their steamers with wire, but it remains to be seen what the result of this will be. In so far as radial stress this may be secure, but the bursting force is not all in this direction. In our opinion, Mr. Ferranti's method of making up large steam pipes of a number of separate ones—a cluster of pipes, so to speak—is by far the most promising solution of the problem that has yet appeared.

English engineers, especially Mr. Howden, of Glasgow, have entered into an extensive discussion of the Belleville and other water-tube boilers, this far, as well as we can judge, with a fair defense of the cylinder or Scotch type for marine purposes. At any rate the advantages of the new type of boilers are not so apparent and extensive as is commonly supposed; in fact, tables prepared by Mr. Howden from actual performance on board ships show superior results for a given weight, in favor of cylindrical boilers. Mr. Howden says: "I have treated the comparison between the cylindrical and water tube boilers on the points of efficiency, weight and space occupied per horse power. I believe I have shown how conclusively that on all these important points the cylindrical boilers greatly excel water-tube boilers." If there is no gain in space, weight or efficiency, it is quite time this was known and the subject put at rest. On the other hand others produced evidence of a great advantage for water-tube boilers on the same points set forth by Mr. Howden. The contention is instructive and useful.

It is a great pity that Mr. Hiram Maxim, instead of fooling away his time in attempting to make flying machines, which no one wants, did not give the same efforts to the propulsion of road vehicles by power. We are not likely in California to take much interest in this matter, where the ingenuity of a mustang is required to find the way over our roads, but there is a great part of the world where steam or other power-driven carriages is a matter of interest and great utility. No one wants to fly through the air. There are no stopping places there, and "sustention," which calls for most of the power in aerial apparatus, is reduced to a bagatelle of friction on roads and ways, so if there was no other reason than a waste of power, flying machines are, by that fact, rendered impossible in a commercial and useful sense. The French seem to be ahead just now with land carriages, and it is likely if it had not been for laws to prevent scaring horses, we would long ago have had successful road vehicles propelled by power.

Mr. R. E. Horton has earned the commendation of his craft by furnishing in the *American Machinist* of March 29, 1894, an analysis of the Schiele bearing for footsteps, and while his propositions have been called in question by other writers, his treatment of the subject will convince a good many who have cynically disposed of this matter as an etherial refinement or a "fad." A disregard of

this principle or method in machine construction has cost a great deal. Having on more than one occasion described the Schiele bearings and how to lay them out, it is not necessary to go over the ground again, but urge upon mechanics and students the expediency of studying out the subject and applying the method whenever opportunity offers, or when required. An understanding of the conditions under which radial surfaces operate would soon stop rotary engine and rotary pump making, because it is mainly due to unequal wear that this class of machines have failed; so also thrust bearings until a series of collars came into use, and these are but a manner of approximating a Schiele bearing.

ELECTRICITY.

NOTES.

One of the neatest inventions in an electrical way is what they call a "night set," consisting of a small cell battery, arranged in an ornamental form, with a minute lamp, and a recess in which to hang a watch so the dial can be seen during the night. It is a Scotch invention, and the makers claim that the battery will last a year without being recharged, which of course must depend on how constantly the light is used. These little "pea lights" are rather an important part of electrical apparatus, and will, no doubt, reach a more extended use in the future.

It was intended in the present number to give a synopsis of Prof. Farnham's late report on electrolysis of water and other pipes, by the ground currents from electrical railway lines in cities, but the discussion on this paper appearing in the May number of the Transactions of the American Institute of Electrical Engineers came to hand too late. It is true the original paper was extensive and complete, but as a rule the real gist of such essays appears in their discussion, when a concensus of knowledge and opinions will appear. At present it may be said, however, that the subject is of grave importance, and one that should as rapidly as possible receive scientific attention. The electrolytic action even of currents of very low voltage will destroy water pipes in a few months, or even weeks, where the earth is damp and the conditions favorable. Here in San Francisco, where iron and other pipes are laid near the surface, the matter assumes especial importance.

It has been claimed that the works and researches of Nikola Tesla are "theatrical" and impractical in their nature, and it is not surprising, perhaps, that such conclusions are reached, but it is safe to predict that there is not only practical value but revolutionary discoveries to come out of his mysterious work. It is probable that no one has ever penetrated so far into the mysteries that surround natural forces, and those all-prevading elements in which we are enveloped, but of which our senses can take no account. If Mr. Tesla had never done aught but pass a current of 200,000 volts through his body, as it is claimed he has done, that is enough to render him famous, and prove his advanced research in this strange field, but he has done much more than this, and of a very practical kind, in the production of simple apparatus as well as weird riddles that puzzle his colleagues. It is strange, or rather is unusual, to find scientific attainments of so extraordinary nature coming from Servia, of which land he is a native.

Mr. E. H. Booth, Mining Engineer of the General Electric Company, formerly of this city, sends the following letter received from Mr. Clark, General Manager of the Cœur D'Alene Silver and Lead Mining Company in Idaho, in respect to an electric plant furnished to that company :

"In respect to the relative merits of steam and electricity at the Poorman Mine, I will say that the amount saved in fuel is about \$100 a day. This, of course, is due to the fact that we generate electricity by water power. How electricity would compare with steam in the matter of cost, if the former was generated by steam power, I am not prepared to say, but am of the opinion that where steam has to be transmitted a long distance underground, particularly where it is wet, that electricity generated with steam and transmitted to the pumps or other machinery will be found to be the most economical, the percentage of loss in transmission being so much less; in addition to this, the cumbersome steam-pipes, with their destructive effect on shaft timber, is avoided. We have five machines in use; two 175 K.-W. at the generating station one and one-half miles distant from our works, where they are operated with Pelton Wheels under 800 feet head; one 175 K.-W. to drive our concentrator; one 150 K.-W. T.-H. machine for the pump, raising 500 gallons of water per minute 500 feet; and one 175 K.-W. for the compressor. This system has been almost two years in operation, and my experience in that time is that an electric machine to run continuously, as in operating a mine pump or mill, must have at least double the capacity it would require when stops occur—as on a street car, for example."

MISCELLANEOUS NOTES.

The *Ohio Valley Manufacturer* says : "The largest patent suit ever filed in Toledo will be inaugurated in the United States Court there within a few days by ex-Congressman Frank Hurd. The action is to be brought by the American Electric Company, incorporated last week, against the Central Union and Bell Telephone Companies. The invention involved is known as the multiple switchboard, and was patented by Martin J. Carney, at that time an employee of the Central Union Telephone Company there in 1880. It was placed on trial in the Company's Toledo office, and has since been put into use in every telephone exchange in the United States. During all these years the inventor claims he has not received a cent from the Bell Telephone Company for the use of his invention. Damages for not less than \$5,000,000 will be asked when the suit is filed."

There is no doubt a good deal to explain in this matter. The Bell Telephone Company are by far too shrewd to continue in the unwarranted use of a patented invention without some convenient loop-hole to crawl through.

The Esbank Iron and Steel Works, recently opened in New South Wales, seems to have been built in the wrong colony, where they will be exposed to free trade. The works cover ten acres of ground, and from accounts will be an important addition to the industries of that country, where no extensive works of the kind have hitherto been erected. The present *ad valorem* duties of ten per cent. it is likely will be removed before long, and it is to be seen if in that case these works are closed or extended. The colonies of New South Wales, Victoria and New Zealand are at this time furnishing object lessons of great interest and value to the rest of the world. They are flexible and can stand experiments that would disrupt older countries with less land and room, are also examples of how little has been learned in the world of how to found and build up states, even of highly-civilized and intellectual people.

Cocoa is the name of the species of palm that produces the cocoa-nut, a fruit too well known to need description; also, the fiber so largely used for making matting, mats, brushes, etc. *Cacao* is the

fruit of the cacao tree (*Theobroma cacao*) from which we obtain chocolate, and what is universally misnamed by the manufacturers as cocoa. *Coca* is the name given to the South American shrub (*Erythroxylon coca*) which is used by the natives of Peru, Chili, and Bolivia, as the betel nut is in Asia, to allay hunger and thirst and supply a stimulant which gives energy to endure extraordinary exertion, and from which the well-known drug cocaine is prepared.

Some idea of the difficulties we labor under on this Coast in respect to fuel are brought to our mind by a contract made last month for the delivery of 15,000 tons of coal at the Joliet Prison, Illinois, at \$1.54 cents per ton for lump coal. The price in Chicago was \$2.00 per ton for Illinois coal, and from \$3.10 to \$3.40 for Pennsylvania and Ohio coal. Anthracite was nearly double these rates, and the question arises why there is not more anthracite coal burned here in San Francisco. It is likely that hard coal commands in Chicago and other western cities a price far beyond what its heating properties represent. It is a cleanly and desirable kind of fuel, also is much more convenient, and the furnaces for house heating are mostly arranged for hard coal. These things influence the price a good deal. Here we have everything arranged for soft coal, and anthracite is but little used, and consequently the latter may be cheaper for heating than soft coal for that reason.

A correspondent of the *Mechanical World*, in England, claims that the American machine-made watches are much better than either English or Swiss watches at the same prices, and this is no doubt true. There is no country in the world where machine processes, such as apply in watch making, have been so successfully carried out as in this country, and there is also the advantage of longer experience and higher paid labor, which commonly means cheaper production in the skilled arts. There is also the advantage that workmen sell their "work" not their "time," and this is no small matter in any manufacture, as we have pointed out in another place in this issue. The American watchmakers have on the whole had a good deal of tribulation and a good many failures, but have all the time maintained a market for their watches in Europe, which is certainly evidence of superiority and evidence too that in a product, mostly one of labor, there is no danger of foreign competition.

Mr. C. A. Gregory, in a recent article in the *Irrigation Age*, gives some statistics respecting irrigation works in British India, and estimates the cost at \$150,000,000. These works consist of dams and other impounding means, canals and ditches, all constructed by the Government, mainly to prevent famine by drouth, which was common over large districts. The revenue varies from $4\frac{1}{2}$ to $39\frac{1}{4}$ per cent., the average being about per 8 cent. The Egyptian works, when completed, such as are now planned, will, no doubt, equal or exceed in cost those in India, but there is possibility of much greater extension in the former country, where there is no limit of either land or water.

It is rather hard to account for an exhibit of the affairs of the Canadian Pacific Railway at its late annual meeting, when the net earnings for the year were set down at \$7,841,416. To this must be added interest on credit loans of money and other earnings. A surplus of \$337,681 was carried forward after declaring a dividend of $2\frac{1}{2}$ per cent. on the half year, thus making the surplus fund \$7,261,213. A railway with a surplus of seven millions of dollars is a rare thing at this day, and betokens good management. It is often said that the syndicate that constructed the line profited by various concessions, including the western section that was given to them, but all this is carried to capital account, and has nothing to do with a five per cent. annual dividend. The company have a capital of \$238,420,508, of which \$65,000,000 is stock. The cost of service must much exceed that of any of the lines in this country. The distances are greater, and the accommodations good in every way, as one may see and judge.

The editor of the *American Engineer* has happily cried out against the stupid and provincial custom of omitting the definite article in writing English. It grows out of a propensity or taste that is not easy to define farther than to call it ignorance, and we caution our younger readers against a habit of so writing. Whatever other merit their remarks may have they are frequently not read beyond the first omission of the definite article. A quotation given is "Steam pipes in smokestack are connected to end of steam or dry pipe in smoke arch." We quote this to show just what is meant by omission of the article. Worse than this is abbreviation of words

as found in Trautwine's Pocketbook. Such a method of writing and printing would be more excusable in a romance or humorous composition, but is never found there because the writers are usually scholars. In technical matter, where the powers of speech are often insufficient to convey the subtle explanations necessary, it is certainly not the place to drop out words or parts of words.

In a late writing of Mr. Ambrose Bierce is this sentence: "In the peasant politics of a republic is room for every animal that has learned to balance itself on its hind feet." Without in any way dealing with the truth or propriety of the sentence, it is a study in the use and powers of English expression. Carlyle, more than any other man of his time, employed the strange powers of our tongue to make impressions on the mind. Such influence is wonderful. One will read over a phrase of Carlyle's, and not at once catch its meaning, but the words remain in memory as a kind of puzzle, and in the end the true meaning breaks upon the mind to remain there for life. This power of our language is manifested in different forms. The ponderable diction of Dr. Johnson, for example, is like reading or rendering ideas in music.

The Chesapeake and Ohio Railway, that owns a line of trans-Atlantic steamers, are carrying grain from St. Louis to Liverpool, England, for 26 cents per 100 pounds. The distance is about 4,000 miles, and the rate is lower than on some of our California lines, where the charge is about the same for carrying 100 miles, or, compared by distance, forty times as much. We have in mind the cost of carrying freight from the Clear Lake Basin. The Chesapeake and Ohio Railway is reported to have been sold to a new company, or at least the main part of the stock transferred by its owner, C. P. Huntington, who, it is said, proposes to give more of his attention to the Southern Pacific Company's interests in future. The lines under this system are pretty well attended to now.

"INDUSTRY."

JOHN RICHARDS, EDITOR.

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CENTRIFUGAL PUMPS.

BY JOHN RICHARDS.

INTRODUCTORY.

The essay to follow will be a peculiar one in some respects, a technical subject dealt with empirically, and in many cases by controversion of assumed data respecting centrifugal pumps, perhaps mistakably now and then, but in all cases from observation and actual experience in designing, constructing and operating such pumps.

These pumps are a class of machines *sui generis*, that defy the mathematician, and, as an old workman once remarked to the writer, "have more tricks than a circus mule." One of these tricks is to give no external hint of the complex forces and condition set up in operating. For this reason, and for various other reasons, they have no literature to this time that has much aided those who make centrifugal pumps.

There is, perhaps, not in the whole range of organized machines any other that will not admit in greater degree of rules that have general application. Formulæ, such as exist, are ignored by the practical pump maker, who soon learns, to his cost sometimes, that

computations will not supply proportions or define the working conditions required, and that he must proceed tentatively and tediously to ascertain the best forms of construction for particular uses, and for the head or pressure in each case. This statement will require some explanation.

Lying before us while writing this is data for constructing centrifugal pumps by M. D. Thompson, taken from Vol. XXXII, Transactions of the Institute of Civil Engineers, London, in which it is stated that an 18-inch centrifugal pump will work well with a 20-foot lift, and a 36-inch pump will do the same with a 30-foot lift. There is nothing in the context to explain this, and perhaps need not be. It is not explainable.

In the same connection is a table in which the diameter of the wheels or impellers is given as a measure of capacity. For example, an impeller 12 inches diameter will discharge 1,200 gallons a minute, and one 24 inches diameter 4,800 gallons a minute. These are examples of centrifugal-pump literature as it now exists, taken from Molesworth's Pocket Book, edition of 1893.

These proportions are almost without the pale of comment, and the same remark applies to a good deal besides, including a constant rule to lay out the curve of the vanes given irrespective of the head or speed, also the statement that the speed of small impellers in feet per second is $8\sqrt{H}$, and large ones $9.5\sqrt{H}$. As all these things will be referred to in remarks to follow they need not be criticised independently.

In other authorities are found tables of efficiency attained with concentric and volute chambers, giving such efficiencies as 1 to $1\frac{1}{2}$; also the efficiency of vanes due to their form, varying from 20 to 40 per cent., without in either case including, or even mentioning, the head or the velocity of the impellers, but the strangest of all is in one case where the diameter of impellers is made a function of the diameter of the suction pipe or the inlet at the sides of the pump, the head, and consequently the speed of revolution, not being taken into account.

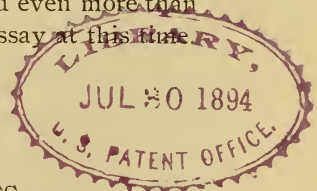
In "Hydraulic Power and Hydraulic Machinery," a recently issued work by Prof. Henry Robinson, under the heading of "Centrifugal Pumps," is found the following :

"For raising large quantities of water a small height, a 'centrifugal pump' (which is practically an inverted turbine) is a very suitable form of pump. Appold constructed the first, and it has been the basis of all subsequent ones. In this form of motor it is neces-

sary to bear in mind that the greatest efficiency can be only obtained when it is applied to work under a constant head. The calculations on which the shape and design of the motor are based, show that an equally good result cannot be obtained when the head is variable. A velocity of about 5 feet per second for the flow of the suction and discharge water is generally regarded as that which should be aimed at. The disc friction varies as the square of the diameter, and the loss due to total frictions increases as the cube of the velocity. Experiments with centrifugal pumps have established an efficiency of about 50 per cent. in the small pumps, and about 70 per cent. in the large pumps. The shape of the curved vanes of the fan materially affects the results, the best form being that in which these are bent backwards."

These remarks we think will confirm what has been said about the literature of centrifugal pumps. The "inverted turbine" suggests carelessness of statement. There is scarcely any analogy between a centrifugal pump and a turbine, in so far as the forces at work in the two cases. The other propositions, including the invention of centrifugal pumps by Appold, will be considered in a future place.

One other circumstance of an introductory nature requires mention here. The intention was at first to republish, with revision and extension, the subject matter of a series of articles written in 1886 for the *Mining and Scientific Press*, San Francisco, giving such facts as could be gathered respecting the origin and history of centrifugal pumps. A second conclusion was that this matter would have increased interest if preceded with some explanation of these pumps, and the methods of their construction and operation for various purposes. This as may be supposed, even in as condensed a form as possible, will greatly extend the space at first contemplated, but the importance of the subject warrants this, and even more than it is possible for the writer to include in such an essay at this time.



I. CONSTRUCTIVE FEATURES.

In preparing designs for centrifugal pumps the first element to be considered is capacity, or the velocity and volume of water to be raised or forced. Velocity comes first, and is commonly less in the case of large pumps, where power is more considered, than for small ones. This is commonly arranged the same for both inlet and discharge ways in large pumps, and from 5 to 10 feet per second, as the

permanency of the duty may warrant. By this is meant that if only intermittent duty is required, as in irrigating and reclaiming land, there is a point where the interest on investment in the larger machinery and slower flow, costs more than is gained by the avoidance of friction in larger machinery and a reduced velocity.

For this reason the velocity of flow in pump orifices is usually much increased over that in suction and delivery pipes when these latter are long. A desirable rate with small pumps of 6 to 12 inches bore is, for the inlet pipes, 5 to 6 feet per second, and for the discharge pipes, 7 to 8 feet per second. Between the inlet and discharge are the waterways of the pump. These are not at control and can follow no rule, as will appear further on.

The velocity or flow of the water in the suction and discharge ways of a pump being determined, the volume or capacity is next to be considered, and is easily found by simple computation expressed in gallons or cubic feet per minute. The next element to be determined is the diameter and number of revolutions of the wheel or impeller.

THE SIZE OF IMPELLERS.

The diameter of these will at first seem to depend upon the velocity of the radial flow between the vanes, so the water will make one revolution while in or around the impeller, the flow being uniform with that of the inlet and discharge ways, but here the designer is first called upon to disregard one of the laws of hydraulics and assume dimensions from a different standpoint.

The speed of the periphery of an impeller is governed by the law of acceleration for falling bodies, $V = \sqrt{2gH}$, or, expressed in feet per second, 8.025 times the square root of the head, commonly called for simplicity eight times the square root of the head. This circumferential velocity of the impellers will raise a column of water to the assumed head, but the additional pressure required for discharge or "flow" must be added, so it is common to estimate the velocity of impellers about 20 per cent. more, or $10\sqrt{H}$, which answers as a general rule, although the result is modified by the form of the vanes and the depth or width of the discharge chamber beyond the vane tips.

To proceed here by inference, or, as we may say, mathematically, the diameter of the impeller, or the number of its revolutions, as before mentioned, should depend upon the path of a particle of water

through and around the impeller, and as this need not exceed 360 degrees, or one revolution, there seems to be clear ground to proceed upon.

Assuming, for example, a head of 36 feet, then $10\sqrt[3]{36} = 60$ feet per second, or 3,600 feet per minute, will be the velocity of the perimeter of the impeller, and if the pump is of 12 inches bore, and the wheel, as is common in practice, is 3 feet in diameter, this will call for 382 revolutions per minute, which is a full limit for the endurance of the spindle bearings, in fact is more than good practice will permit. If the diameter is made according to some rules given, twice that of the inlet pipe, then the number of revolutions would rise to 573 per minute, and the result would probably be a failure of the spindle bearings.

At the slower speed of 382 revolutions per minute for the impeller, and assuming the service flow in the pump orifices to be 7 feet per second, or 420 feet per minute, we find that if the water is to be carried through one revolution the radial flow will be, counting from the axis, at the rate of 573 feet per minute, then the waterway through the impeller would be reduced about 8 per cent., and the velocity increased accordingly. Such an arrangement would cramp the inlet flow and cause obstruction to solid substances passing through the pump, so the section of the water ducts in the impeller have to be increased and the water carried through 500 to 800 degrees of revolution, for mechanical reasons.

The discharge area at the periphery of the impellers, if made uniform with the outlet and inlet orifices of the pump, would be liable to clog, even in ordinary service, so this is usually made of double area, and the radial flow reduced to about 50 per cent. of its velocity in the inlet and discharge ways of the pump.

It will therefore be seen, unscientific as it may seem, that the diameter of the impellers of centrifugal pumps, and consequent size of casing, is based upon mechanical and operative reasons, and not on any hydraulic law. The safest way is to assume a limit of speed for the spindle-bearing surfaces not exceeding 350 feet per minute and from the revolutions thus obtained lay out the impeller accordingly. A good rule is to divide 1,000 by the diameter of the spindles in inches for the number of revolutions per minute; this will suit in all cases for water pumps.

The waterways of the pump, through the impeller and throat and elsewhere, must also be arranged to suit the nature of the duty to be performed. In some cases, as in dredging for example, the

velocity of the current may have to be reduced by enlargement of the throat to one fourth what it is in the discharge nozzle or inlet to avoid danger of clogging.

PUMP CHAMBERS.

The bore or capacity, diameter, and speed of revolutions being determined, the next element is the casing or pump shell, and here again we meet with complexity. It was mentioned that one authority gave for volute shells an advantage of 20 per cent. in efficiency, which may be true, and less than true in some cases, but will not apply at all in other cases. The impelling power in centrifugal pumping consists of two separate forces, centrifugal force, and what is called tangential energy, or "mechanical push," due to the action of the vanes and force of discharge from the impeller, but these forces vary relatively with the head, and in such degree as to supplant each other at high and low heads, and on this circumstance depends the value of volute or spiral pump chambers or "casing," as they are commonly called.

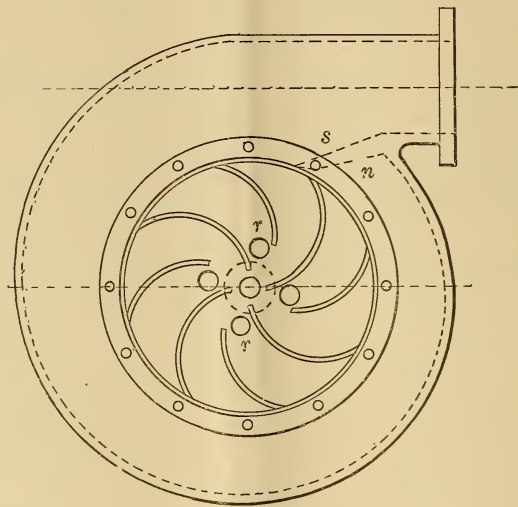


FIG. 1.

Referring to Fig. 1 it will be seen that the casing is in effect a portion of the discharge pipe, and may be thus considered, so a constant velocity of flow therein can be assumed for all heads. This being constant, and the tangential energy or velocity of discharge

from the impeller being as the square root of the head, it is easy to see how rapidly the conditions change as these velocities are varied relatively. At a head of 40 feet the tangential discharge will be 63 feet per second, impinging on a body of water flowing at a tenth of this rate. This, expressed mathematically in terms of *vis viva* momentum and velocity, will show a considerable impulsive effect, for example: If M is the weight of the impinging water, and V its velocity; M' and V' the weight and velocity respectively of the water in the pump shell, and the lines of force are coincident, but the directions of flow are opposite, then

$$\frac{M}{M+M'} \frac{M'}{M'} (V+V')^2 = \text{the inductive effect of the tangential energy.}$$

As a matter of fact, however, no such result takes place in practice; the angle of impingement is uncertain, depending on several circumstances, such as the velocity of radial flow, or width and form of the impeller, also the form of the vanes.

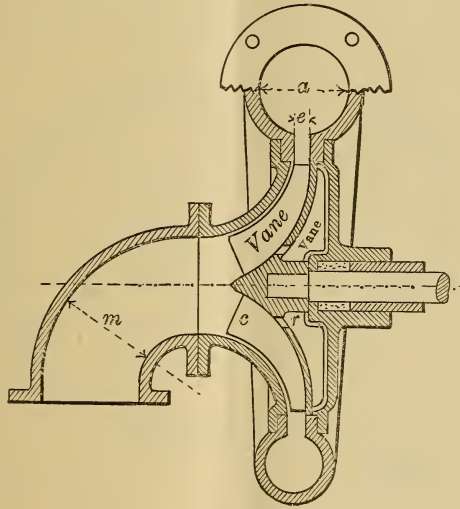


FIG. 2.

The thin stratum of water discharged at c , Fig. 2, into the main discharge at a velocity ten times as great, disturbs and breaks up the solidity or normal flow in the discharge-way, and, as experience proves, produces no useful effect that need be considered in designing pumps to operate against heads exceeding 40 to 50 feet. This statement the writer feels called upon to explain, is based upon experience in dealing with heads from 40 to 100 feet in a large

number of cases where tangential energy was provided for, and in other cases where it was disregarded, that is, concentric and volute casing gave the same result. This may be called one extreme.

Proceeding now to the other extreme, for low heads of two to five feet, there is found a wholly different set of conditions, modifying the form of the pump chambers, and various other features of a constructive nature. For constant low heads, such as occur frequently in draining operations, there is a complete change of conditions, so much so that centrifugal force as an impelling force may be disregarded.

For low heads the velocity of the impeller or the vanes need not follow the rules before laid down. For heads from 2 to 5 feet it will be as follows: $10\sqrt{2} = 14$ feet; $10\sqrt{3} = 17.3$ feet; $10\sqrt{4} = 20$ feet, and $10\sqrt{5} = 22.3$ feet per second. With these low heads it is not necessary or expedient to limit the discharge flow to 8 feet per second. This could be raised to correspond with the velocities above noted, but should not exceed 12 feet. A pump under these conditions becomes an impact or "pushing" machine,

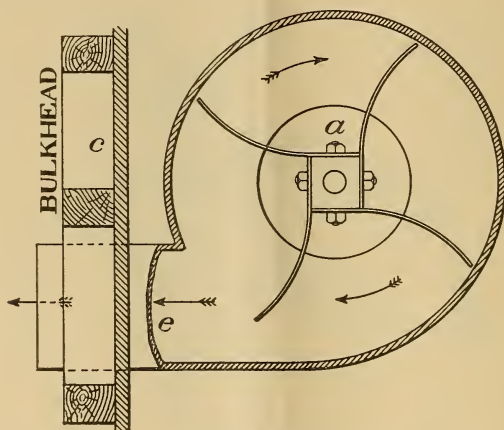


FIG. 3.

corresponding to and almost identical with what is called a scroll impact water wheel reversed, the action comparable also to common water-lifting wheels, such as are employed at New Orleans and in Europe generally, for low and nearly invariable heads.

There is also the problem whether there should be any free or discharge space beyond the tips of the vanes except a discharge-way carried off tangentially, as in Fig. 3. In this case, taken from

actual practice, for a head of $3\frac{1}{2}$ feet, the centrifugal action was almost entirely ignored, the impeller fitting close in a concentric chamber and the blades curved forward instead of backward. The inlet a was 50 per cent. greater in area than the outlet e , and the section of the latter, as well as that of the main chamber, rectangular. The pumps were vertical, submerged, and arranged to work through a bulkhead c , no valves or pipes being required. The result fully confirmed the hypothetical reasoning on which the scheme was based, namely: That under the circumstances the circumferential velocity, or the vane velocity, would correspond very nearly to the discharge flow.

The writer has employed the same method with success for river dredging pumps where the head was but little, being only the difference between the river's surface and the point of discharge. The advantages gained by such construction for pumping stones or other solids are very important, and more than compensate for any loss of efficiency, such as may occur.

The impact of the vanes against boulders or stones is avoided when the vanes are moving at nearly the same speed as the discharge flow, and solid substances are not thrown out violently against the casing as in the case of a common centrifugal pump. There is also an avoidance of clogging, which is almost sure to occur with a volute chamber, by solids becoming lodged or wedged in between the vanes and the case; also much less of the abrasive effect of gravel or sand discharged radially than with a common pump will cut through the shell in a week or two of continuous service. Here we have another wide infraction of all rules laid down for pumps of this class, a disregard of nearly all the features that apply to water pumps for heads of ten feet or more.

The efficiency of a pump made in the manner shown in Fig. 3, or with a concentric chamber, the vanes curved either forward or backward as the relation between their speed and that of the discharge flow may demand, is from 40 to 50 per cent., as nearly as observations in practice can determine.

VOLUTE PUMP CHAMBERS.

The next element to be considered in centrifugal pump construction is the section and shape of a volute chamber when the conditions of service demand that form, that is, for heads from 5 to 40 feet, or perhaps 50 feet.

A theoretical form of the volute or spiral casing should, to maintain uniform velocity of the discharge water, begin at nothing, and gradually expand to the discharge bore for a finish, but here again we are compelled to abandon the theoretical road, because of certain operating conditions.

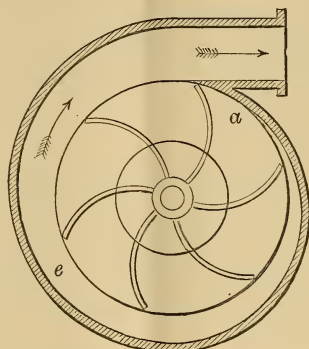


FIG. 4.

Referring to Fig. 4, which is a diagram showing a theoretical volute chamber such as is employed by a good many makers of such pumps, it seems correct, but there is no provision for radial or outward flow for some distance at *a*, consequently the water contained and flowing between the vanes is checked in its course once on each revolution, while passing this point.

The writer made this mistake in 1883 in designing a pump to raise the surface drainage in the City of Sacramento. The pump is yet in use, giving a fair efficiency after ten years of service, but it developed a queer phenomenon that remained for some time a problem for which no clue could be found. The pump when started set up a series of rhythmic pulsations, causing vibration of the timber supports on which it stood that made it disagreeable to stand near the machinery. The first impression was that the impeller was not balanced, but it was soon discovered that the frequency of the vibrations or pulsations did not correspond to the revolutions, but to the revolutions multiplied into the number of vanes, and it will be no disparagement to admit that the real cause was not understood for some years later when other experiments proved where the difficulty lay.

Since that time the writer has in all designs for water-raising pumps of this class began the volute at *n*, Fig. 1, with one fourth

to one sixth the area or section it has at the discharge a , thereby sacrificing a considerable portion of the tangential energy, and causing an accelerated flow in the casing. This necessity for space in the discharge chamber at n , and the throat or cut-off plate s , is well understood. Messrs. Gwynne, of London, have always arranged their pump chambers in this manner. The cut-off or baffling plate s will be considered in a future place.

The nearness with which the vanes approach the volute chamber, or the radial depth at e , Fig. 2, does not seem to be a matter of importance in a pump's operation, but regulates a constructive matter of some importance, namely: whether the pump chamber has to be parted through its axis to insert the impeller, or whether this be done through removable side plates, as in Figures 1 and 2.

In the latter case a pump chamber can be cast in one piece, and erected so the discharge will be at any angle, the side plates, inlet and spindle bearings remaining undisturbed. This method has been a characteristic of the practice of Messrs. J. & H. Gwynne, above referred to, and is certainly desirable in nearly all cases, the exception being when there is no room at the side to remove the impeller, and when the shaft must pass through the pump, as in the case of circulating pumps for condensing water on board ships. Convenience and symmetry favor the solid volute casing with removable side plates.

THE VANE CHAMBER.

The tapering form given to these chambers is an attempt to maintain uniform area and consequent velocity of the water in its radial flow from the inlet. This is a rule of hydraulics, the violation of which causes a considerable loss of power if not observed, and brings us again to a point where centrifugal pump construction must diverge from theory.

Referring back to Fig. 2, and supposing the dimension m to be 30 inches, the area will be 707 inches, and to maintain an uniform velocity of the water this section must be maintained out to and through the throat e . For an impeller 60 inches in diameter the perimeter will be 188.4 inches, this divided into 707.8 gives a width of 3.76 inches, which is too narrow if any kind of debris, such as grass, roots or drift wood, is to be passed through the pump. This difficulty increases with the diameter of the impellers until at a head of 50 feet the area should be double that of the inlet m , and for

higher heads in proportion, especially when encased impellers are employed, as will be explained in a future place.

The curves in the water-ways in Fig. 2 are supposed to be as perfect as can be attained, and are taken from designs made by the writer in 1886, for the Westinghouse Machine Co., of Pittsburgh, Pa., also for Messrs. W. T. Garratt & Co., of San Francisco.

IMPELLERS OR WHEELS.

These are made in three forms:—with open vanes only; with a disc or side plate open on one side, as in Figures 1 and 2, and encased or with two side plates, as in Fig. 5. There is also a type having hollow arms that set the water around them in revolution, and thus avoid circulation back through the inlet, as will be further explained in future.

The function of the impeller being to set the water in revolution, its construction in respect to efficiency is not a matter of much importance, but there is a vast difference in the conditions under which pumps operate with open and encased impellers. Leaving out for the present the plate form with vanes on one side, and considering the open and encased forms only, the difference is one that would never be supposed from inference.

With the open form the whole mass of water within the pump is set in revolution, and the surface friction is between this mass of water and the side plates.

With the encased form the water within the impeller is set in revolution, and the surface friction is between its outer surface and the stratum of water between it and the side plates. The water friction is just the same in the two cases, and is always as the area of sides of the pump chamber, but there is this difference as to construction. The surface over which the whirling water flows must be true and without deviation in a radial plane, so that with an open impeller the side plates should be turned true on the inside, and with an encased impeller its exterior surface should be turned true.

The object of encased wheels or impellers is mainly to secure strength, which is vastly increased by this form, and is necessary at high speeds or for high heads, but there are operating conditions to provide for that considerably complicate the method and are open to objection. With an encased impeller the whole interior of a pump chamber is subjected to a static pressure equal to the discharge head, and this demands heavy side plates of ribbed section, and even then with high heads flexure is almost unavoidable.

In the case of what are called pit pumps in California, one of which is shown in section at Fig. 5, the head is often 60 feet or more, sometimes reaching 80 and 90 feet. At 60 feet the pressure is about 26 pounds per square inch. The impellers are 30 inches or

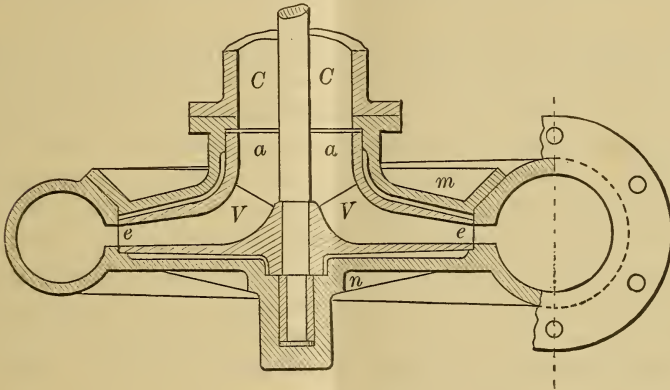


FIG. 5.

more in diameter, and the sides of the pump case including the discharge volute, when that form is employed, will make up a diameter of 42 inches, and area of 1,385 inches, sustaining under a head of 60 feet a static pressure of 36,000 pounds, or 18 tons of internal strain on each side, so that a pump chamber not well ribbed will expand under such a force and be broken. At lower heads, and with larger pumps, this difficulty is less, but remains a factor to be carefully taken into account in designing centrifugal pumps of all kinds.

If the impeller is open the pressure on the side plates is in a large degree removed, because at the center of the pump, or over the inlet area, there is not only no internal pressure but a negative or inward pressure, a partial vacuum, which gradually, and in some ratio not understood, changes to outward pressure, from the inlet to the discharge chamber. Theoretically such change of pressure would be a constant increase, but in an experiment made some years ago, holes were drilled through side plates at distances of three inches or so from the inlet pipe outward, and no water was discharged until it reached almost to the periphery of the impeller, which was 40 inches in diameter.

In another case a small pump having an impeller 20 inches in diameter was sold to a miner to be carried into the mountains and

employed to raise water 110 feet. He was informed that the side plates were only three eighths inches thick, and the pump would certainly burst. He replied laconically that "the pump was as heavy as he wanted to transport on a mule, and if it burst he could mend it." A letter from him informed the maker that the pump was "all right."

This difference in internal pressure between open and encased impellers is of course modified by revolution of the stratum of water between an encased impeller and the side plates, and as no additional friction would result it would be an improvement no doubt to employ shallow vanes on the outside of such impellers, so as to set the water in revolution against the side plates. This would not only relieve the latter of most of the discharge pressure but would meet and prevent what is a serious objection to encased impellers, that of loss by circulation. With an encased impeller of any kind having no vanes on the outside there must be a running joint around the inlet nozzle, maintained against the discharge pressure. This can be explained by referring to Fig. 5.

Supposing the inlet *a a* to sustain a negative or inward pressure due to a suction head of 20 feet, or 8.6 pounds per inch, and the discharge throat of the impeller *e* subjected to a discharge pressure of 40 feet, or 16.2 pounds per inch, then as no water joint can be maintained around the periphery of the impeller, the space at its sides, above and below, will be filled at this same pressure of 16.2 pounds, which if added to the negative or inward pressure of 8.6 pounds produces a force of 24.8 pounds per inch, tending to circulate the water through the running joint at the inlet nozzle of the impeller. Whatever water can pass here, and it is commonly a good deal, is only circulated in the pump, and represents lost work.

The writer in his practice has usually employed several ledges or collars and grooves to obstruct such flow, and ended up with the abandonment of encased impellers, except when a fibrous packing around the nozzle could be employed. With clear water, where no grit or sand is present, these running joints can be maintained tolerably close, but this loss by circulation is always a matter of uncertainty, and not observable or even ascertainable after a pump is once erected except by an obvious loss of efficiency. Unquestionably the best way is to have vanes on the outside of an encased impeller, so as to cause revolution of the water there. As before remarked, there is no difference between the friction of the water against the side plates of the pump and the friction against the sides of the

impeller. It is the same thing when the surfaces are alike in the two cases.

BALANCING CENTRIFUGAL PUMPS.

We have now reached the most interesting problem in centrifugal pump construction, that of balancing the lateral thrust upon the impellers. It is a matter that modifies nearly all the constructive features of practice, and is, by any fair standard of comparison, one of the most intricate problems in hydraulic apparatus.

Some years ago, during some experiments at the University of California, Prof. F. G. Hesse discovered the force developed on discs having different degrees of centrifugal action on each side, and prepared an essay on what he called a "hydraulic step" to resist weight or thrust, explaining the forces by formulæ. This paper was widely circulated and remarked upon by Professor Unwin and others. At the same time, however, this method of balancing weight and thrust was in practical use in California, for sustaining the weight of shafts in pits, but without Professor Hesse's knowledge, having been discovered in practical working.

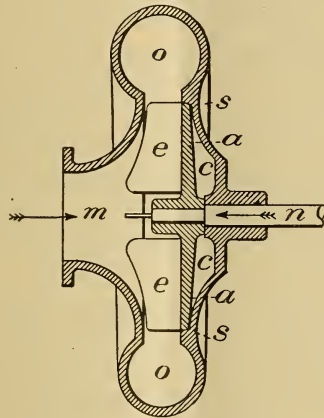


FIG. 6.

To illustrate the nature and amount of lateral thrust on the disc form of impellers for pumps, and referring to the diagram, Fig. 6, suppose the inlet at m to be 12 inches diameter, and have an area of 113 inches, and that the head to be operated against is 40 feet, also that the impeller disc a on the shaft n is 36 inches in diameter and provided on one side with a series of vanes e . The pressure in the

discharge chamber will be 17.2 pounds per inch static, or in operating at least 18 pounds per inch.

To find the unbalanced pressure and inward pull on the shaft *n*, the difference of pressure on the two sides of the plate *a* is not an easy matter. On the front or vane side there is the impingement of the entering water against the plate, which if curved, as in Fig. 2, would amount to but little, certainly not more than 100 pounds for a flow of 6 to 8 feet a second.

There is also the increasing outward pressure from the inlet outward, due to centrifugal force, but, as remarked in a previous place, the amount of this force is not known, but it certainly does not exceed one fourth of the exposed area multiplied into the discharge pressure. Deducting the area of the inlet leaves 593 inches of area for the disc on this side, which if multiplied by one fourth the discharge pressure gives 2,668 pounds, and, adding for impingement, 2,768.5 pounds for the front or vane side.

On the rear side of the plate *a* toward the chamber *c c*, if there is no rotation of the water, there is by reason of the water passing over the rim at *s*, a pressure equal to the discharge over the whole surface, except the area of the shaft *n*. This pressure or thrust will be $706.8 \times 18 = 12,722.4$ pounds, or, less the area of a shaft 3 inches diameter, 12,596 pounds, from which must be deducted the counterbalancing pressure of 2,768.5 pounds on the front side, leaving unbalanced the enormous force of 9,953.9 pounds. This is an extreme case, assumed for the purpose of illustration. No one at all acquainted with the matter would think of designing a pump in this manner, unless this lateral thrust was required for some purpose. It cannot be safely resisted by thrust collars of any kind, even when these are under water.

It is not an easy matter to determine when an impeller is not balanced, or the amount of lateral thrust upon it. It must be remembered, however, that it is always in proportion to the field of water rotation on the two sides, and this naturally leads to the conclusion that a pump should have an inlet at each side. This would be correct if it were not possible to balance the centrifugal action on each side without double inlets, and in this manner secure not only complete equilibrium, but also attain other important advantages of both construction and operation. It is not always desirable to balance centrifugal pumps, on the contrary the lateral thrust on the impellers becomes essential in some cases, as will be explained farther on.

(To be Continued.)

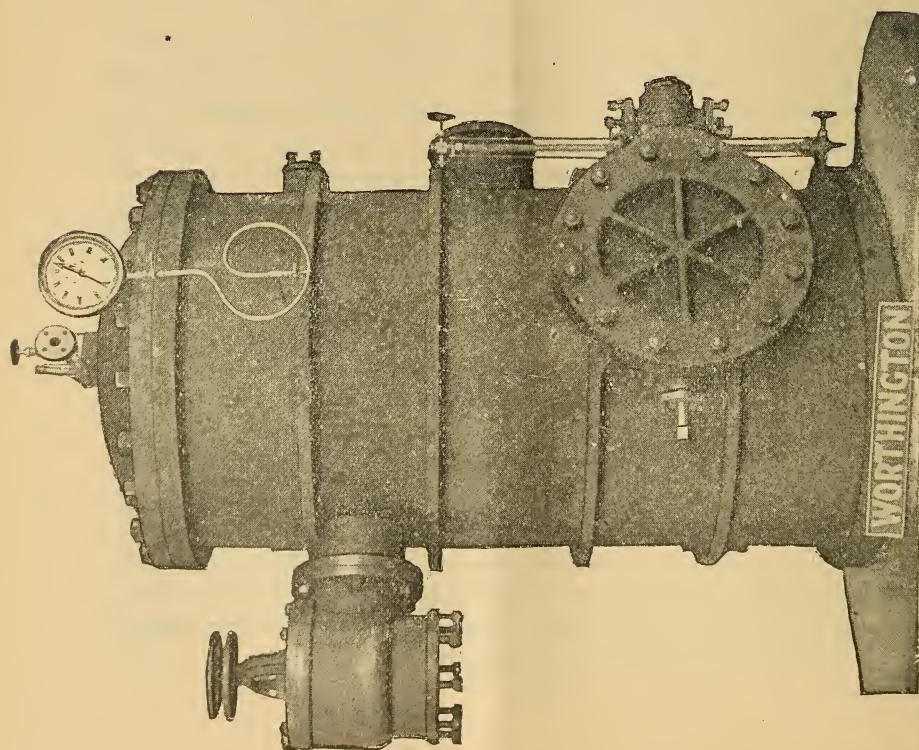
THE VULCAN BAND-SAW MILL SUIT.

IN 1893 a suit was brought by Messrs. Smith, Meyers & Schnier, of Cincinnati, Ohio, against the Vulcan Iron Works, of this City, for alleged infringement of certain patents on band-saw mills, granted to Mr. Smith of the firm before named. The case was tried before Justice McKenna, of the U. S. Circuit Court for Northern California, and decided against the Vulcan Iron Works on two principal counts in the complaint, and the case was appealed by the defendants to the U. S. Circuit Court of Appeals, and was there retried, with the result of reversing the first decision, and sustaining the plea of the Vulcan Iron Works that their band saw mills did not infringe on any valid claim in the Smith patents.

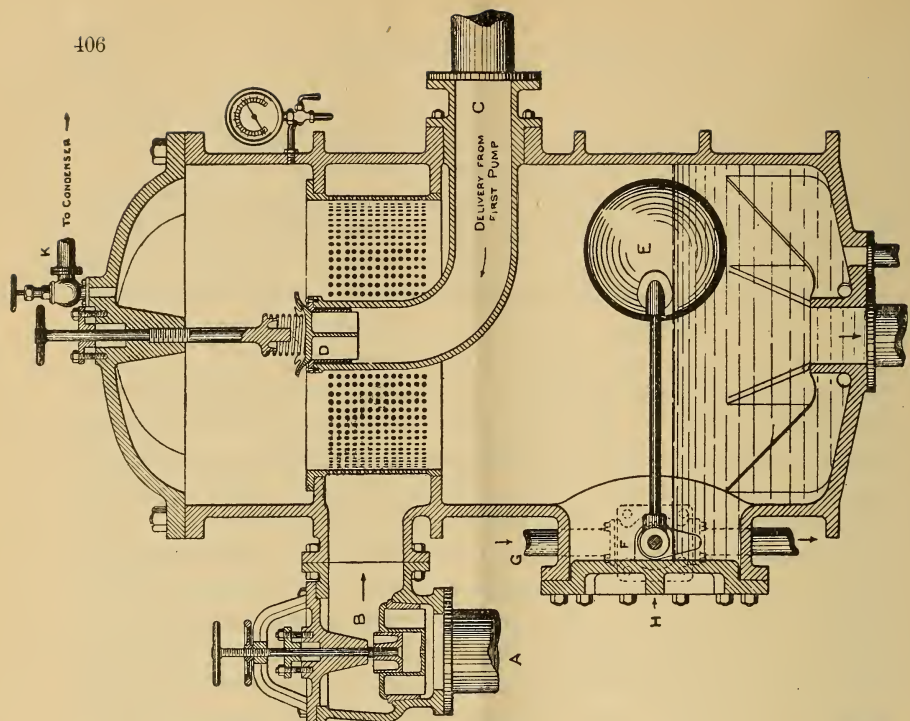
Our main purpose in noticing this matter is to offer some comments upon the decision of May 28th last, by Judges Gilbert, Knowles and Hawley, Judge Gilbert delivering the opinion of the Court. The subject matter of this decision would form a consistent essay for a technical book or journal, and serves to remind one of the versatile knowledge, perception and powers of language required in exercising judicial functions in a proper and just manner.

Our appreciation of this matter is heightened by the fact of "having previous to the first suit gone over the various inventions and mechanism involved in the Vulcan band-saw mills and that of the complainants, also other machines back to that of Newberry, 1808, and now finding in Judge Gilbert's decision a complete resumé in technical terms of nearly every element and condition existing in the subject matter of numerous patents. In the present case the plaintiff, no doubt, construed his rights according to the terms set forth by the claims of his patent, and he had certainly a right to such an assumption, because if, on the other hand, the Examiner had concluded the claims were too broad they would have been "rejected." By parity of reasoning they should be sustained, or, in other words, the Examiner was empowered to judicially condemn the patent, but not empowered to give it validity. The patent should have been issued on Mr. Smith's responsibility, as it really rested in the end, then he would have been more careful to see that the claims were not too broad.

The Vulcan Iron Works have been very successful in constructing these large band-saw mills, and now that the patent controversy is ended, and their own patents recognized, they will, no doubt, extend this department of their business.

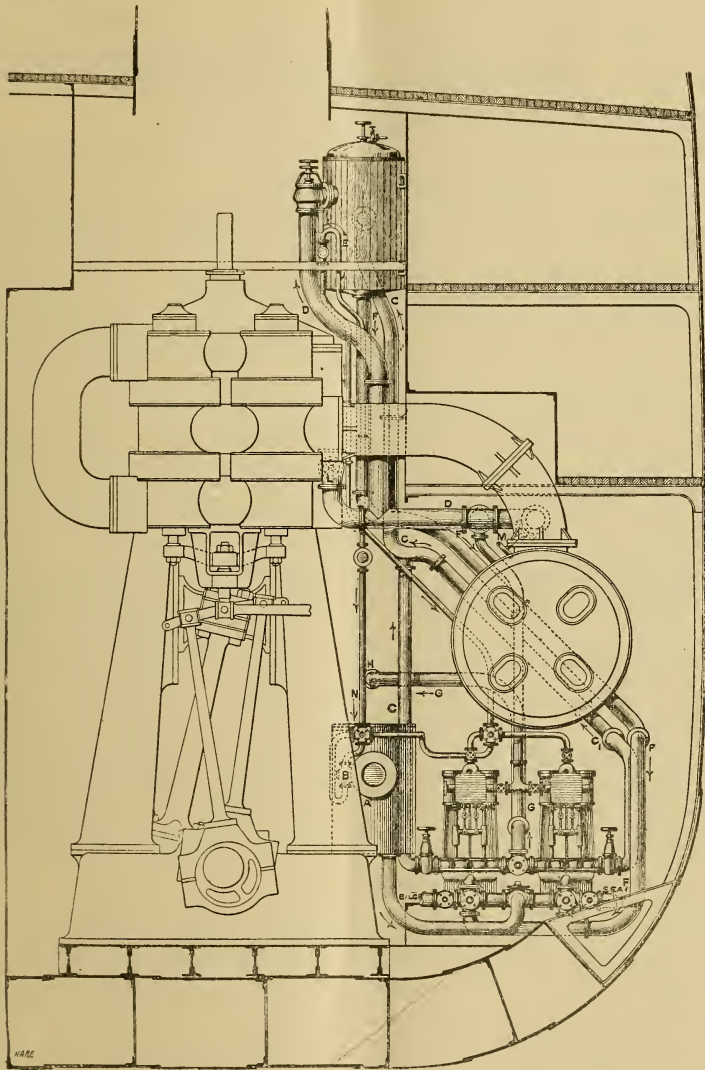


ELEVATION.



SECTION.

WORTHINGTON MARINE FEED-WATER HEATER.—H. R. WORTHINGTON, NEW YORK.



MARINE FEED-WATER HEATER.

HENRY R. WORTHINGTON, NEW YORK.

The elevation and section on the page opposite, and diagram above, represents a feed-water heater adapted for marine use.

We are apt to think that water pumped from a hot well is at a temperature high enough to enter a boiler, and is, if we compare with cold water, which continues to be in some cases fed into boilers,

but it must be remembered that water in a hot well has been employed to condense steam, and this is the point to be avoided with feed water. The economies on shipboard at this day call for a boiler supply as near the boiling point as possible.

As friend Watson, of the *Engineer*, knows more of marine matters, we quote his description of the heater :

“ The steam condensed in the surface condenser is delivered over by the air pumps into the hot well *A*. This being intermittent it is necessary to regulate the working of the pumps in order to insure their always being completely filled with water. In the hot well there is therefore a float which operates the valve *B*, and controls the working of one of the pumps, gradually opening the valve as the water rises in the hot well, and shutting it off in case the water is not delivered over as fast as the pumps take it away. The pump in connection with the hot well delivers the water through the pipe *C* or *C*¹, as the case may be, into the heater through the spray valve seen in the section. The exhaust steam from the various auxiliaries, which is turned into the main exhaust trunk *D*, is conveyed to the heater, where it thoroughly mixes with and imparts its heat to the feed water. The water, as it accumulates in the heater, raises the float, which opens the steam valve *E* controlling the second pump, and passing from the heater down through the pipe *F* to this second pump is forced by it into the feed-supply pipe *G* leading to the boilers. On the exhaust trunk *D* is a valve *L* leading to the low-pressure casing, and any steam which is not utilized by the heater goes into the low-pressure cylinder and again does useful work, or in the opposite case, if there is not enough exhaust steam from the auxiliaries to sufficiently heat the feed water this valve can be used to regulate the amount of steam admitted to the heater to increase the temperature of the feed water to the degree desired. By the valve *M* the exhaust steam from the auxiliaries can be turned into the condenser when required.

These pumps are perfectly automatic. Either pump can be arranged, by the valves shown, to work in connection with the hot well or the heater, or can be worked quite independently of the control gear by means of the three-way valve *N*, and used for pumping from the sea, or for any other service that may be desired. It is a matter of considerable importance in case of emergency to have these large and powerful boiler-feed pumps available for fire or general service, as in such cases they can be run at very high speeds ; and, moreover, it entirely obviates the necessity of employing an extra set of pumps.”

Many of our readers will remember how it was demonstrated some time ago, and proved by thermal computations, that the feed or supply water for steam boilers could be most economically heated by direct steam drawn from the boilers for that purpose. Nothing has been heard of the matter for a year past, it was, no doubt, a fallacy. The Worthington heater seems more in the line of rational procedure.

EXTRACTS FROM A NOTE-BOOK.

BY "TECHNO"

No. XXIII.

DEACON BARTON.—A CORPORATION WITH A SOUL.—A QUESTIONABLE
MILL SITE.—JUNIUS JUDSON.—A RACE PROBLEM.—ELECTRIC
TOWING.—SCHEMES AND CRIMES.

On leaving Rochester, my Uncle told a story, a very unusual proceeding for him, especially when the nature of the story is considered. I noted it down, briefly, as follows :

"Old Deacon Barton, a man who could hardly live and do business in these times, began here at an early day, fifty years ago at least, to make edge tools for carpenters, coopers, and others. He was an ingenious, industrious, honest man, whose name you would find revered in memory like one of the old saints, if you were to inquire in Rochester now. He prospered, and after many years of toil and self-denial, had built up two factories ; the upper one about the falls somewhere, and the other some distance down on the western side of the river.

"His tools were made honestly, of good steel, properly tempered, sold at a reasonable price, and 'warranted,' which meant that any faulty tool would be replaced, even if it were employed to tap turpentine trees in North Carolina. His name became a mark of good quality, and was known all over the country. But calamity came. The Genesee River got in an angry mood and washed the upper factory over the falls, into oblivion, with a good share, more than half, of Deacon Barton's hard-earned capital.

"He had left, a good name, a wide trade connection, and the lower factory. A great struggle and some goods bought from other makers enabled him to fill his orders and hold the trade. The lower factory was increased, and when it was fitted up so as to produce the product of the annihilated one, there came a fire and swept the whole thing off the ground. Nothing remained but a bed of smoking coals—not a pound of anything useful ; and now I come to the part of this story I want you to observe.

"Away out in Ohio, then a pioneer Western State, was another tool-making works, a large and opulent company, composed of true men, as will appear. A meeting of the directors of this Ohio company was called ; their mechanical manager was called in and instructed to go at once to Rochester and render any assistance he

could to Deacon Barton, and request him to send all his orders to the Ohio company, to be filled on his account, at a discount that far exceeded the usual profits of trade ; also to send for any goods he required at Rochester, and for aid of any kind.

“The foreman reached Rochester early in the morning, next day, and went down to the ruins of the burned factory, yet smoking and hot in places. A tall old man, with bent form and gray hair, was walking around the black spot, a picture of despair, the only person there. The foreman asked him if this was the place where the Barton Tool Works were burned, and where Deacon Barton could be found? ‘This is the place,’ said the old man, ‘and I am Mr. Barton.’

“The foreman then told the story of his instructions, and the Deacon’s head bowed lower and lower until the end ; then, reaching out his hand to his visitor, it was seen that his face was covered with tears. He said, in a choking effort, ‘I had given up, but I will try again.’

“That day and the next plans were made for a new factory, and various other matters arranged. It was built and succeeded wonderfully and quickly, so the Deacon at the end of a long and useful life went out to rest in the cemetery at Rochester, without a debt, and without having ever owned a dishonest dollar or injured a fellow man. I was the foreman.”

“My Uncle, at this point, like the venerable Deacon, was too full to add a comment on the changed spirit of our time, when the destruction of a competing works is too often regarded as good fortune for the rest. I knew what was in his mind, and could write it out here, but what would it avail? The place is or was familiar to my Uncle, and he soon went on talking.

“On nearing Rochester, a common remark to all strangers is: ‘Here is where Sam Patch made his last leap.’ Few living now ever heard of Sam Patch. He was a courageous mountebank, who jumped from high places into the water, and wound up by jumping into the pool below Genesee Falls, and never came up again.

“There was formerly, forty years ago, and may be now, if we could see through the hoarding, a saw mill on the very brink of the falls, so near indeed that the log carriage when long timber was sawed, projected out beyond the end of the mill and over the boiling pool below.

"I remember when quite a boy, and long before the falls were fenced in for cupidity's sake, lying down on that log carriage and waiting for the slow feed to work me out over the falls, looking down into the raging cauldron below, and imagining poor Sam Patch's ghostly eyes looking upward. I could not move, and had to wait for the sawyer to 'gig back' and then get off with a cold shiver down the spine, to run away and never see Genesee Falls again until now, and not even now, because they are, as we are informed, converted to a peep show at so much a head for the privilege to go behind the high fence.

"Here was founded one of the important industries peculiar to this country—the manufacture of engine governors as a distinct article of trade. It is near forty years ago since Junius Judson began to make his governors here and sell them to steam-engine makers all over the country, much to their and his gain too, if he had let the lawyers alone.

"I am doubtful if he ever knew the real points of his manufacture, because he spent most of his time in discussing law suits, and 'graduated openings,' meaning thereby the shape of the ends of balanced cylindrical valves used. These were trimmed off to form what he called a 'double ogee,' a thing that had no importance whatever. The real points were first and mainly an organized manufacture of a job requiring workmanship far beyond the resources of any ordinary machine shop; and second, the high speed and consequent high angle of the suspension links, or increase of centripetal force, required to operate the valves.

"Previous to this, engine governors were made to swing around like children at a Maypole, and in a sedate manner that took no notice of a change of five per cent. in the speed of an engine. Between these leisurely moving weights and the 'butterfly' valves, there was commonly a lever and a lot of loose-jointed tackle that would catch up after the engine had been diverging for some time toward a faster or slower gait. Judson altered all this, and the manufacture became permanent, as it should have done, and is now a wide and useful one. Mr. Porter, perceiving the effect of high speed and a powerful centripetal force, produced his governor, better still, but more expensive and not suited for trade purposes, but I have wandered away from Rochester."

—————"Here," said my Uncle, as we pulled out of the station, "we begin a country worth observing. There are apple orchards without end, a veritable apple district, cheese making and

high farming. The land is maintained here, and it is one of the few places where it is maintained. Schools and colleges are as thick as grog shops in Paisley, and the people among the best, physically and mentally, in the whole country, but not quite as good as farther west and adjoining, in what is called the 'Western Reserve.' The name came from some kind of juggling about proprietorship and a concession from the State of Virginia, that owned the land to the same extent that the prophet Mahomet did, but that don't matter now; what I was going to remark is that hereabout, and thereabout especially, the New England emigrants came a century ago, and by drinking limestone water, working hard, and having a broad environment, their bones grew, their minds expanded, and their views broadened, until in the second or third generation they have become the best people on the continent, that is, they have in the highest degree industry, ingenuity, thrift, and education.

"These lakes we are coming to, I am happy to say at a reasonable speed, are a wonderful factor in the affairs of this country. Only being found out, however, in these latter years. The iron, copper, and timber at the upper end of the chain, more than a thousand miles from here, has made their importance mainly, but there is also a wonderful commerce to supply the Northwest — an empire of itself — and now it is proposed, as a parting stroke, to utilize the waters where they pour down at Niagara, 150 feet or more at a clean leap, to the level of Lake Ontario.

"Of this latter matter, people over-estimate it. What is it but money saving, and not much of a saving at that? A concentration of manufactures at one place instead of many places. As an increment to permanent wealth the works are a good property, and the effect within the radius of possible distribution will be beneficial. Remember, I am not disparaging the scheme at all but complaining of the extravagant and provincial remarks one hears about 'harnessing Niagara,' and the dawn of a commercial millinimum. It may save some coal, and reduce the price of that, but the price of coal does not depend upon demand and supply, when we come to think of it."

This view of the Niagara enterprise was new to me, and seemingly a mistaken one, but there are certainly some extensive social points to be considered in connection with concentrated and segregated manufactures. A diversity of pursuits seems to be an essential feature in the normal development of community, and manufacturing towns confined to a single industry are not of the best among municipalities.

— We are now skirting along the Erie Canal, and I took the opportunity of getting at my Uncle's views of electrical propulsion for the canal traffic, knowing that he had been considering the subject. He was, I imagine, about to speak of it, because he had been figuring for some time, and referred to his note-book as he went along.

"This scheme," said he, "is what may be called a 'slop over,' and has for its principal object a franchise of special privilege, with some kind of provision to get control of the canal traffic, and prevent the use of horses and steam engines.

"The mechanical phases of the matter may not admit of solution at this time, but it is hard to see what the object is of generating power on shore and conveying it to a boat by a trolley wire; but they say 'we will get power from the falls.' Suppose they do; power is like potatoes, and will bring the market price no matter where it comes from, but the main thing is that water-craft of all kinds should be as the professors call it, 'auto-mobile,' and the objection to mules is in the fact that mule power fails at the end of the tow path, as electric motors do at the end of the trolley wire. If accumulator batteries were possible in the case, and I do not see why they are not, then a boat might roam around at pleasure, but then comes the original query: why not generate the power on board? The limitations are, boats with a four-knot model, that cannot be expedited with an electro motor, or any other means, and a waterway that will not stand the 'swash' of more speed without damage. It is not a problem of power at all, and much less the kind of power, but of various other things, including an electric franchise.

"Governor Flower, who being a lawyer and a banker must know all about engineering matters, started this thing in a rhetorical section of his message last year, and is now one of the company proposing to use electric apparatus. I don't believe in it. Am sorry that I cannot, but there are so many who do, my opinion cannot matter much. There are two kinds of progress in the world, physical and moral, and it is about time that the physical part came to anchor until the moral part catches up.

"Powerful navies, flying machines, canals in Central America, and a tunnel under the Straits of Dover, six railways across the American continent, and fifty-million exhibitions seem mixed up with strikes, disorder, and an increase of crime, especially stealing. I can well mind when a certain penitentiary had 600 inmates. Now

it has 2,600, and another thousand should be there that would have been convicted and sentenced if tried at the time when the 600 were in prison, so the proportion is six to one. Strikes, turmoil, corruption, discontent, socialism, and the rest, are the product of physical change too rapid for social adaptation.

"This seems a long way from an electric canal, but there is a connection."

(To be continued.)

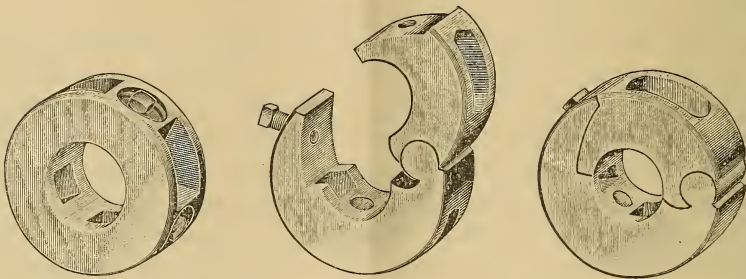


FIG. 1.

FIG. 2.

FIG. 3.

A MANUFACTURE OF MACHINE COLLARS.

The Gouverneur Machine Co., of Gouverneur, New York, have engaged in a new and useful manufacture of shaft collars in the forms shown in the drawings above, and will no doubt be successful.

Among the various fittings in machine works, one of the most expensive, and at the same time imperfect in details, is collars for shafts. If made with section enough to cover clamping screws the dimensions must be an exaggeration. If the heads of the screws are permitted to project these are a source of danger, so much so that the practice should be interdicted by law. If the screws are flush, and threaded the whole length, there is the abomination of a screw driver. If to be immovable, and set into a recess, collars take the awkward form of clamps, so the whole matter is unsatisfactory and unmechanical.

If the collars above have the qualities claimed, and that may be fairly inferred, and are well made, there is no doubt of their soon finding a place among "machine supplies."

Fig. 1 shows a solid collar that must be put on from the end. Fig. 2 is a split collar, opened so as to be passed over a shaft, and Fig. 3 the same collar closed, as it appears when in place. The

screw being diagonal in respect to the radius produces a clamping action that insures the collars to run true. We are not informed of the material or price, which can be obtained from the manufacturer at the address given.

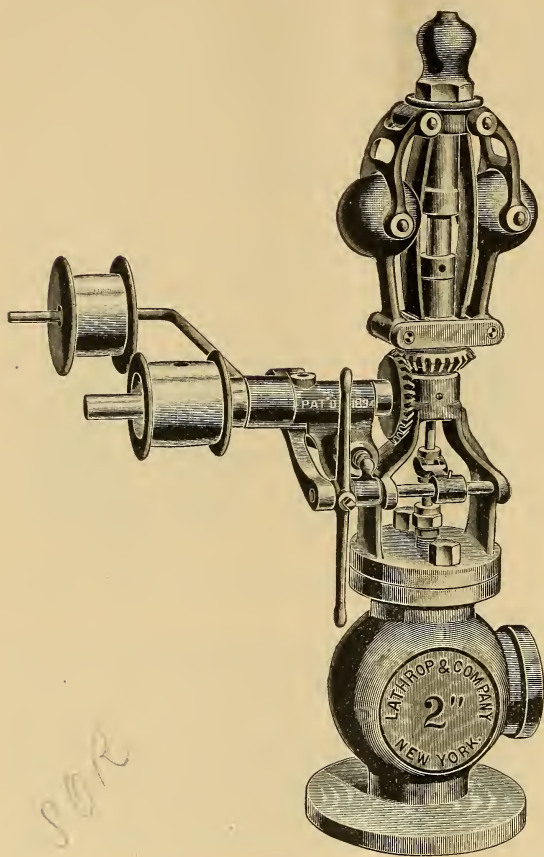
EVAPORATIVE CONDENSERS.

Evaporative condensers have come up again for consideration, and it seems to us should have more attention here in San Francisco, where, if anywhere in the world, they should succeed. Fuel is dear, the air is cold, and water is scarce. A late modification of such condensers, called Ledward's, has been erected in a number of places in England with very favorable results. In this case advantage is taken of what the Germans call *rippenheizkörper*, that is, ribs or radial flanges projecting out from the pipes, and operating on what is sometimes euphoniously called the "pot leg" theory, conspicuously present in the Servé boiler tubes, but for absorption of heat in that case.

Mr. T. Westgarth, in *Industries and Iron*, No. 1108, thus speaks of the Ledward modification :

"The tubes are placed horizontally, their special feature being the corrugations, which very largely increase the surface and cause a better distribution of the cooling water. I have examined one of these condensers fitted up at the saw mills of Messrs. H. Quayle & Sons, Liverpool, and found it giving most satisfactory results. It was condensing the steam from a horizontal compound engine working at 100 pounds pressure, and indicating 200 horse power, the vacuum varying from 27 to 28½ according to the state of the weather. Mr. Quayle informs me that much less water is now being used since this condenser was set to work, and altogether he finds it very satisfactory. It is placed over a tank on the top of the engine house, and consequently occupies no space useful for other purposes, and, of course, in this position there is free access for the air to circulate between the tubes, which materially assists the working of the condenser. I think it will be of interest to state that my firm is putting down two of these condensers, one of which is for 1,400 indicated horse power, so that I shall be able to give the results of a trial upon a fairly large scale in due course."

Any firm here who will work out the subject would be sure to secure profitable orders for condensing apparatus of the kind, but San Francisco is a peculiar place in respect to innovations. Anything invented here is commonly pressed on with a good deal of vigor, but in things that have their origin elsewhere we manage sometimes to bring up at the "tail of the procession."



THE LATHROP STEAM-ENGINE GOVERNOR.

LATHROP & CO., NEW YORK.

The invention, development, and manufacture of steam-engine governors in this country, as an organized and separate manufacture, has been creditable to the ingenuity and skill of our mechanics.

The manufacture as a distinct branch is now at least thirty-five years old, beginning with Junius Judson, at Rochester, New York, about 1860, but since that time has been extended and improved until but few of the original features except high speed remain.

The latest design in regulators is shown in the drawing above, in which the makers claim to have attained an extreme sensitiveness of action, and various features of safety and convenience that certainly seem to be borne out by the design.

Centripetal force or resistance devoid of friction and with a constant ratio to the centrifugal force, is one of the conditions of close regulation, so also is good workmanship and material, especially for deflecting springs, all of which seem to have had full attention in the Lathrop governors shown above.

The governors are made suitable for engines of all sizes and adaptations where throttling regulation is employed, and we sometimes think there will be more of this in the future than in the immediate past. The Automatic cut-off method has for some reason gone ahead of what some people think are its true bounds in steam engineering.

RIVER MINING.

What is called river mining, that is, raising gold from the bottoms of streams, has not on this Coast kept pace with other branches of the mining arts, a thing to be much wondered at when the amount of fluvial gold-bearing areas are considered.

In 1891 there were at work in one district or section of the Clutha River, in New Zealand, fifty dredging machines. The industry has since declined because of the poverty of the material, but dredging is yet carried on to a considerable extent where the circumstances are by no means as favorable as in almost any of the northern rivers of California. In fact it is to be doubted if the delta of any stream in the world of like size contains so much gold as that of the Feather River. By delta we mean where the river enters the alluvial plains and the reduced velocity permitted precipitation.

During the present season there will be a number of attempts to mine the northern river beds, and some novelty, no doubt, of methods introduced, but without, so far as we have learned, in any case plans for careful and effectual exploitation, except where streams are deflected or flumed away from their channels, as above Oroville.

Subaqueous work by means of bucket or suction dredges, especially the latter, when stirring or disintegrating machinery is employed, can never be an effective way of securing gold from river beds. Where there are no boulders, and that is exceptional, buckets may cut into and raise the spoil without losing the gold, but where there are crevices or boulders the chances are that only a small share of the gold is or can be secured by bucket or suction dredging. A more rational way of proceeding would be to bare sections of the

bottom by means of caissons, and carry on the work as it would be done in the placers or on dry ground. The air pressure to expel the water from a caisson would balance the external head so there would be no loss of power compared with the present methods of pumping, and the work could be carried down to bed rock.

Mr. Calvin Brown, C. E., of this City, patented in 1890 a portable caisson for submarine work that was provided with a kind of flexible mouth to fit down over irregular surfaces on the bottom that should be adapted for this river gold dredging. The caisson was mounted on a barge, or rather was suspended in a well way in a barge, so as to be raised and lowered by proper tackle, and the whole moved from place to place as the work progressed. There was an air lock to permit the removal of material, and for the passage in and out of workmen and their implements, but in the case of dredging for gold the material except boulders could be more easily raised by means of centrifugal pumps.

Workmen on the bottom of a river in a caisson of considerable size, 8 to 12 feet in diameter, could go to work in the regular way, and if a caisson could be fitted down so as to exclude water beyond what a pump would raise it would become real mining. The head to be pumped against would be compensated by the air pressure, and be no more than the elevation of the discharge above the river surface, of course a like volume of air would have to be sent in, but the loss would be trivial in comparison to passing spoil through an air lock. The scheme is well worth a trial, and would be much cheaper than fluming and deflecting a stream, and certainly more effective than working blindly over the ground.

OUR MERCHANT MARINE.

Last month we published in a brief note statistics respecting American-owned vessels sailed under foreign flags. Since then we have received from Hon. Eugene Chamberlain, U. S. Commissioner of Navigation, a report on the iron and steel steamers engaged in the Atlantic and Gulf fruit trade that is still more discouraging. It is no pleasure to publish such statistics, but in view of pending legislation it becomes a duty to point out the disgraceful position the American people have been thrust into by meddling legislation and a paternal attempt to foster this industry.

The steamers engaged in the fruit trade to the West Indies are of about 750 tons register. They are not subsidized by any govern-

ment, and indicate very clearly the effect and tendency of our Navigation Laws and system of taxation, dues and "vexation," which is a better term. The following tables, taken from the Commissioner's communication of May 23rd last, shows how this fruit trade is conducted.

"The following is a summary, compiled from the tables of iron and steel steamers as far as ascertained, employed during the current year in transporting fruit, chiefly bananas, from the West Indies and Central America to the United States :

	No. Strs.	Gross Tons.
American flag and register. { American build	4	4,531
Foreign build	8	6,540
American ownership. { British flag	10	11,786
Italian flag	1	900
Time charters by Americans. { Norwegian flag	37	26,548
English flag	6	5,305
Danish flag	2	1,165
TOTAL.		
American flag	12	11,071
American owners, foreign flags	11	12,686
American time charters, foreign flags	45	33,018
	68	56,775

The tables appear to indicate :

First.—That there is little or no construction in American shipyards of vessels for this service. The latest of American build in the tables was constructed in 1880.

Second.—That those in the business purchase foreign-built vessels for the trade. In tables B and C, 19 such, of a gross tonnage of 19,226 tons, are noted.

Third.—That American owners of such foreign-built vessels desire to sail them under the American flag. Table B gives eight vessels of 6,540 tons which have been admitted to American registry and it may be noted that a bill is now pending in Congress to admit two more in table C, the Athos and Claribel, of 3,078 tons, to American registry.

Fourth.—That in 1890 British yards began building steel vessels especially for the trade, and in the following year Norwegian yards began the construction of the same class of vessels; that in fact these countries now furnish Americans with the vessels they require for the purposes of the fruit trade, that such vessels are built to American order and contract, on charters covering a period of years, and of late furnished with American names.

Fifth.—That the general law forbidding American registry to foreign-built vessels does not promote shipbuilding for the American fruit trade in American yards, nor stop shipbuilding for the American fruit trade in foreign yards.

Sixth.—That the registry law, except where waived by special Act of Congress, compels the use of foreign flags over American

property employed in this business, that it tends to increase the employment of foreign officers and seamen on vessels which Americans own outright, or in which they have a considerable pecuniary interest covering a period of years.

Seventh.—That it compels Americans, if owners of vessels under foreign flags, to place their property under the government and laws of foreign nations, and to contribute to the support of such governments, or if charterers for a period of years indirectly to do the same, and incidentally to pay the profits on such charters annually to foreign citizens.

Finally, so far as this trade is concerned, the registry law in effect requires American capital to share the profits of its investment in navigation with foreigners, and to be employed in increasing the field of service of foreign, not American, sailors."

Want of space prevents us from giving the extended tables with the name, tonnage and nationality of the vessels in this trade.

We too well know the arguments brought forward to show how these vessels are manned by foreigners at reduced wages, and how they could be built here if there was some way discovered of forcing this by law, and in answer we only ask respect for the disinterested opinion that all this shipping would have been built here, owned and sailed under the American flag if our laws were as favorable to shipping as in countries where these foreign vessels came from, also that there is nothing to do in order to revive our shipping but to "let it alone," stop taxing it like shore property, and then again for landing, and other privileges. In short permit the American people to build, own and sail their ships as they build, own and operate their railways.

THE TECHNICAL SOCIETY OF THE PACIFIC COAST.

Mr. G. W. Sherwood, C. E., a member of the Technical Society, presented before that Association, at their regular meeting on June 1st, in this City, a paper on the Nicaragua Canal, where he has been engaged, that will be a surprise to a good many people, but not all. The account is most discouraging in respect to what has been done, and is far from encouraging for what is to be done. The fact is the truth has not been told in respect to the canal. His views are confirmed by a special correspondent sent out to the Isthmus by the *New York World*, whose report appeared on May 2nd last, but has not, that we have seen, been reprinted or commented upon by the press.

The author's views of the physical impediments to be overcome are such as to cast grave doubts upon previous showings in this matter, and the climatic difficulties are also serious. The main impediment of all, in our opinion, was the fact brought forward by Mr. Geo. W. Dickie at the end of the discussion, that the Canal if made would be for other nations mainly, we having but little shipping to go through it. The following is from the stenographic report of Mr. Dickie's remarks :

"It is quite a new idea that this country should construct a canal in another country for the benefit of other nations spreading commerce, to be operated at cost without any interest on the outlay. That is not a doctrine that has prevailed in reference to American commerce. The practice has been the very opposite. To illustrate this we need go no further than San Francisco. This City deeded away her water front to the State. It is not a sea-port town at all, but is 150 feet from the edge of the harbor. The wharves have been constructed, not at the expense of the State nor at the expense of the country, but on revenue drawn from shipping of the port. A ship constructed or owned by a San Francisco merchant has to pay taxes the same as a house. This building we are in gets the advantage of the street, of the City lighting, of the sewerage, and every advantage that taxes are spent for. The ship owner gets nothing. When his ship comes to the wharf, which is the same as a street is to a building, if it carries six thousand tons or over, he pays \$36 a day for lying there. We need legislature to remove the burdens, which have no parallel in any other commercial community.

It seems to me that the present desire for the Government to take hold of this canal is grasping at something that is outside of our reach, while all the things that would tend to help our shipping are lost sight of. British ships are not charged taxes at home. They are not charged import duties. Whatever is consumed on these ships is free—free from everything, because it is used on the high seas, where there is no possibility of any taxes being spent for the benefit of that property. If the people of the United States would think of these things, and legislate in favor of and for shipping, there would be more inducement for people to help build the Nicaragua or the Panama Canals."

ON ELECTRIC MOTORS.

Professor F. B. Crocker, of Columbia College, at the beginning of the year lectured before the Franklin Institute, Philadelphia, on Electric Motors. This address is so interesting that we produce the following excerpts :

“Joseph Henry, in 1831, was the first to construct a motor which worked by electro-magnetic attraction. This apparatus really has a better right to the distinction of being called the first electric motor than Barlow's wheel. Many other inventors followed Henry in devising forms of electro-magnetic motors. Jacobi in 1834, Davenport in 1837, and Page in 1838, are particularly worthy of mention. Some of these early motors were by no means mere toys, but were of considerable size and power. Jacobi, of St. Petersburg, in 1838, propelled a boat twenty-eight feet long at a speed of three miles an hour; and Page, of Washington, in 1851, succeeded in obtaining a speed of nineteen miles per hour with a car carrying a number of persons and driven by a sixteen horse-power electric motor. This result, by the way, is practically the same as that obtained from the most improved trolley cars of to-day, both in speed and power.

This brief glance at the early history of the electric motor brings out the striking fact that this machine was invented eight years before the dynamo and for several decades it was considered of more importance, both scientifically and practically; the motors of Jacobi and Page, for example, being far more powerful than any contemporaneous dynamo. A search through the patent records of the United States and England would show also that more attention and greater expectations were then based upon the motor. This was undoubtedly due to the fact that inventors hoped to obtain a source of power which would rival or surpass the steam engine. It was gradually realized, however, that the cost of electrical energy obtained from a primary battery is so high that it cannot compete with a steam engine. The number of pounds of zinc consumed in the best battery, per horse-power hour, is about equal to the weight of coal required to give the same amount of energy in a steam engine; and since zinc costs about fifty times as much per pound as coal (in fact it actually requires several pounds of coal to produce one pound of zinc), it is obvious that the primary battery is far more costly than steam in the generation of power. As a matter of fact, electrical energy from a primary battery at the present time costs at least ten times and probably twenty times as much as that obtained by the use of a steam engine and dynamo.

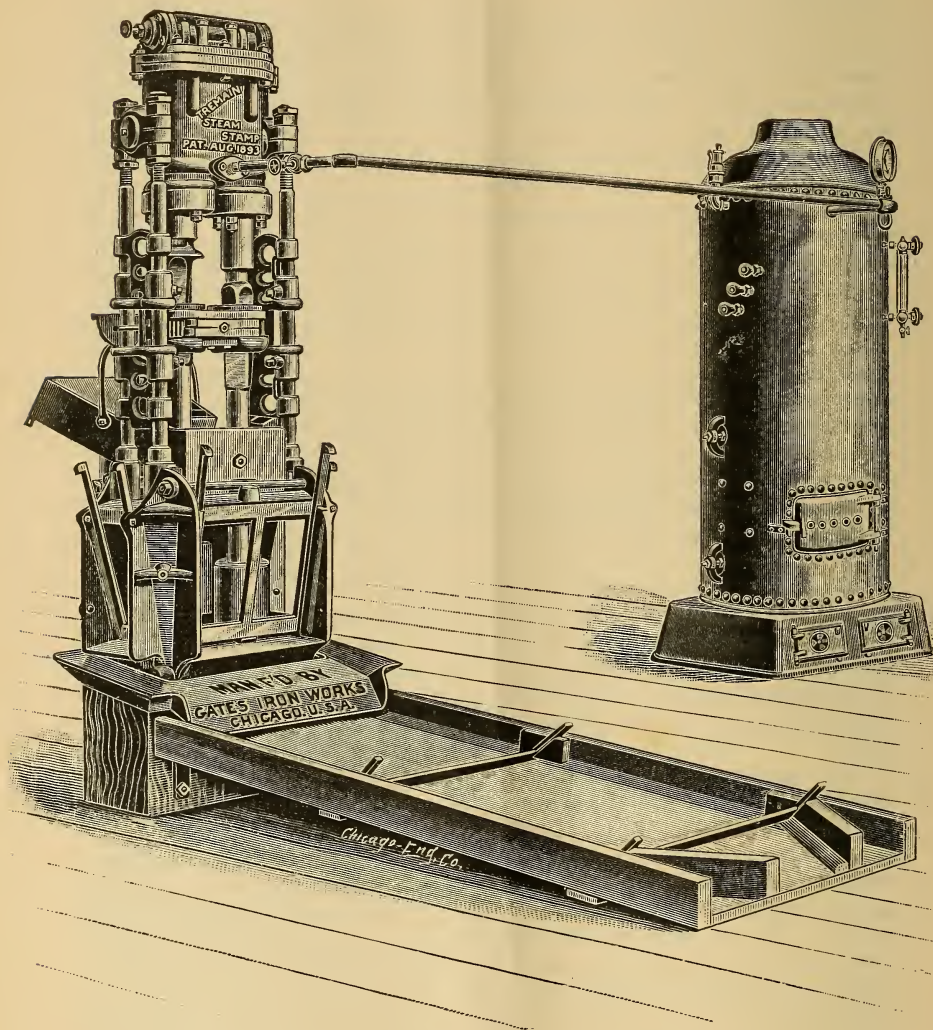
The realization of this serious difficulty greatly discouraged scientific men and inventors in regard to the electric motor. A reaction set in against it, and for many years it was comparatively neglected by the best workers. The dynamo was taken up in its stead and developed in the remarkably rapid and successful manner which is the greatest practical achievement of recent times. The neglect of the electric motor continued until about 1887, the dynamo having by that time reached a state of great perfection and being in extensive use for electric lighting. The development of the dynamo, and the laying of electric light circuits through the streets of many cities and towns, provided the very supply of reasonably cheap cur-

rent which was needed for the motor, and which the primary battery had failed to give.

This fact encouraged inventors and manufacturers to again take up the motor, and since that time its progress in this country has been very rapid ; but even now the motor is somewhat overshadowed by the dynamo. The number of electric motors in use in foreign countries is not very considerable, but in the United States there are probably about 50,000 stationary motors and several thousand railway motors, whereas the number in the whole of Europe is not much more than one-tenth of these figures. This last fact probably explains why the literature of the dynamo is much more complete than that of the motor, since most of the books are written by Europeans—the time of Americans being occupied rather with *making* and *using* dynamos and motors than with telling others how to do these things. The most recent history of the motor includes the invention, by Tesla, in 1888, of the two-phase alternating current motor and the development of the two- and three-phase systems. These important systems are now being practically used, and an enormous electric power transmission plant is being installed at Niagara Falls, which is to be operated by the two-phase system. Indeed, it may be said that the progress of the electric motor at the present time is equally as rapid as, and more interesting than, that of the dynamo. * * * * *

The points in the history of the electric motor to which I desire to call particular attention are these : that for many years it was considered of greater importance than the dynamo ; that it then fell into a position of comparative insignificance, but that in the last few years it has again become very prominent, and in the future it is certain to be of still greater importance, while the dynamo may become obsolete.

In considering the construction and action of the electric motor, the first and most important fact is its great similarity to the dynamo, or, more strictly speaking, it is practically the same machine used in exactly the opposite manner. The dynamo is a machine which generates electric current when driven by mechanical power. A motor is a machine that develops mechanical power when supplied with electric current ; thus the functions of the two machines are exactly the converse of each other ; nevertheless, identically the same machine can be used for either purpose, that is to say, the machine is perfectly *reversible*. It is also a fact that a machine that is good for one purpose is good for the other. The old idea that a good dynamo was not necessarily a good motor, and that considerable differences in construction are required, is, so far as the writer's experience goes, a fallacious one. The tendency now is for manufacturers to make exactly the same machine and use it for either purpose indiscriminately with only very slight differences in the details of winding, connections, etc.



THE TREMAIN DIRECT STEAM STAMP.

THE GATES IRON WORKS, CHICAGO.

In a late issue of this Journal there were some general remarks respecting the direct application of steam pistons to stamps, that have called out several communications on this subject, one from the Gates Iron Works, at Chicago, who are makers of the direct steam

stamp shown above, an invention that seems to have originated in Portland, Oregon.

The slightly variable stroke unavoidable in stamp action, and consequent clearance in steam cylinders, is a small matter in many cases, especially in prospecting plants, when compared with an independent engine and the required details of transmission.

The machine illustrated, of which we have no technical description, seems to operate by what may be called the duplex system of steam distribution, one piston performing or controlling the valve functions of the other. The pistons are of the trunk form, receiving initial steam in the annulus for the up stroke, and then passing it to the top of the piston for the down stroke, thus putting the degree of expansion at control.

Such machines offer great advantages in mountain transportation, being composed of sections and separable into pieces not exceeding a pack load.

DESTRUCTIVE EFFECT OF ELECTRIC CURRENTS.

For a short time past, or within a year or so, there has arisen some strange phenomena in respect to oxidation, or, in electrical terms, the "electrolysis" of metal when buried beneath the surface of the ground in the vicinity of electrical conductors.

This effect has been especially marked in the case of lead, a metal non-corrosive under ordinary conditions, but also extending to pipes of both wrought and cast iron, such as are employed to convey gas and water in cities, parallel to or near the railway lines where electric motors are employed for propulsion, and the return current traverses the rails and earth in their vicinity.

A good deal of light has been thrown upon this subject in a paper, by Mr. Isaiah H. Farnham, presented by request to the American Institute of Electrical Engineers, in April last, and the discussion which followed this paper. The author instituted a series of very complete experiments, and besides collected from various sources a great deal of data bearing upon the important subject of his paper, of which we would be glad to present a more complete synopsis if space permitted.

The experiments and data collected by Mr. Farnham are summarized in certain conclusions set down at the end of his paper, a com-

mendable form for such essays, which we hope to see repeated more frequently in future. These conclusion are as follows :

"1st. All single-trolley railways employing the rails as a portion of the circuit cause electrolytic action and consequent corrosion of pipes in their immediate vicinity, unless special provision is made to prevent it.

2nd. A fraction of a volt difference in potential between pipes and the damp earth surrounding them is sufficient to induce the action.

3rd. Bonding of rails, or providing a metallic return conductor equal in sectional area and conductivity to the outgoing wires, is insufficient to wholly prevent damage to pipes.

4th. Insulating pipes sufficiently to prevent the trouble is impracticable.

5th. Breaking the metallic continuity of pipes at sufficiently frequent intervals is impracticable.

6th. It is advisable to connect the positive pole of the dynamo to the trolley lines.

7th. A large conductor extending from the grounded side of the dynamo entirely through the danger territory, and connected at every few hundred feet to such pipes as are in danger, will usually ensure their protection.

8th. It is better to use a separate conductor for each set of pipes to be protected.

9th. Connection only at the power station to water or gas pipes will not ensure their safety.

10th. Connection between the pipes and rail, or rail return wires, outside of the danger district should be carefully avoided.

11th. Frequent voltage measurements between pipes and earth should be obtained, and such changes in return conductors made as the measurements indicate.

In closing this somewhat rambling paper I can do no better than use words which will remind you of Patrick Henry, 'eternal vigilance' will be the 'price' of pipes and cables where conditions favorable to electrolysis exist."

The discussion which followed this paper was participated in by various members of well-known ability and reputation in electrical matters, but was almost wholly of a technical nature, and without popular interest, which just now is centered upon the fact of how far electrolytic action will destroy water and gas pipes buried in streets where electric railway lines are operated.

There is evidently at this time some "commercial reserve" in the discussion of the problem, but full vigor in investigation, also "hope and promise" of some early discovery of means to prevent what must otherwise demand extreme caution in permitting the construction of electric railways in the crowded sections of cities.

Among the practical hints that appear in the New York discussion of the paper before mentioned is a communication from Professor Elihu Thomson, who suggested the use of "potential reducing motors at various points over the affected areas." This seems rather impracticable for various reasons, and can only be construed as an indication of great difficulty in the problem to be dealt with.

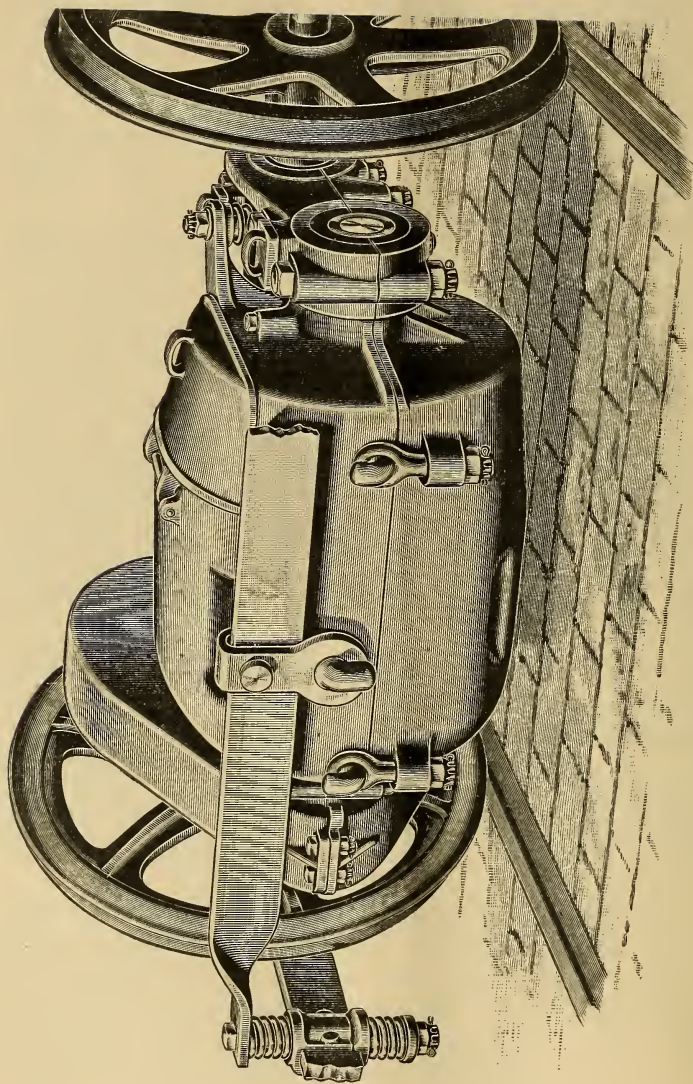
At the Chicago meeting of the Institute, in April, there was also a very interesting discussion of Mr. Farnham's paper, in which Mr. C. G. Armstrong, with other matter of a more serious nature, included the following amusing paragraph :

"Some years ago I was requested to inspect an electric railroad in Indiana, where I had some experience with the erratic action of electricity underground, and where I made some measurements of differences in potential between adjacent conductors. Unlike Mr. Farnham I did not use a voltmeter, but used a mule, that is to say the owners had noticed a variation in the operation and speed of their motors at a certain point. I watched a mule team driven over this place, and found that at a certain point one of the mules became very much agitated to the extent of planting his hind feet on the dashboard of the wagon many times in rapid succession. I had no means of calibrating the mule, but would judge that the potential difference must have been considerable at this point, and upon inspection I found that the rail bonds were broken, and a very disagreeable shock could be felt by touching the ends of the rail at this point."

Mr. A. V. Abbott, closing the discussion at Chicago, used the following significant words, which, in our opinion, furnishes a key to the whole problem of electric railway construction :

"If a street railway company is willing to invest in an electric road the same amount of capital as is called for by the ordinary cable road, a successful conduit system can be at once introduced. The success of the conduit electrical road simply depending upon its being built well enough to do the work required of it."

The "commercially-impossible" phase of the problem lies here. We do not claim that the electric companies should have less profits for constructing railway lines, but that electric lines should not be constructed at all when the investment will not permit the work to be done in a safe and permanent manner. The craze of competition, and the bait of franchises, have tended to thrust forward electric propulsion faster than human powers could perfect it, and some "backlash" must be expected. Of a finally successful result no one can have reasonable doubt.



STREET-RAILWAY ELECTRIC MOTOR.

THE WALKER MANUFACTURING COMPANY, CLEVELAND, OHIO.

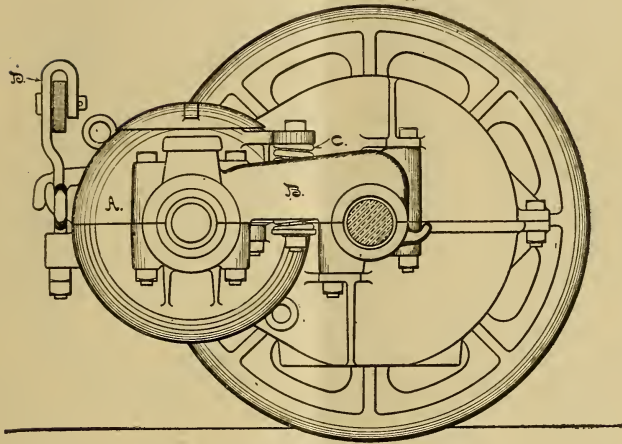


FIG. 2.

ELECTRIC-RAILWAY MACHINERY.

THE WALKER MANUFACTURING CO., CLEVELAND, OHIO.

Most of our readers know the Walker Manufacturing Company as extensive makers of and contractors for cable railway and other heavy machinery, but not until the present time as makers of electric apparatus for street-railway purposes.

The announcement of this branch being added to the works at Cleveland was made some months ago, and with the vigor characteristic of their past history, the company now seem to be fully underway in this new manufacture. The type of motors employed is shown by the drawing on the opposite page, where one is mounted on an axle, with all the attendant parts.

The company send the following description :

" Experience has taught that the greatest cost in operating roads by electric motors has been the repairs made necessary by the rapid deterioration of the track and rail joints, and that the only way to correct this is to entirely disconnect the motor itself from iron to iron contact with the axle, and prevent, not only the hammer blow due to the weight of the motor, but the inertia blow due to the unyielding mass of the motor. Attempts have been made to accomplish this by suspending the motor at or near the center of gravity. This eliminates the weight, but not the inertia blow, which is the most serious. This has produced the conclusion that a perfect motor must weigh as little as possible, be extremely strong in mechanical con-

struction, and should work to twenty-five horse power without heating, and not be in any way attached to the axle and wheels, except through springs which will do away with the hammering of the track to the greatest possible extent. This method of suspension gives the freedom of movement necessary for the removal of strain in rounding curves.

The motors being constructed by the Walker Manufacturing Company combine these suggestions of practical experience. They are of the four-pole type, made of steel, weigh 1,200 pounds, and have easy capacity of twenty-five horse power; will run at any speed up to twenty-five miles an hour. They are controlled by a series parallel controller, of superior type and great simplicity, and are not attached to the axle in any way, except through yielding supports. A steel motor, spring mounted; weighs 1,600 pounds, including gears and gear housing.

The illustration on page 428 shows the general form of the motor, mounted upon 30-inch wheels and ordinary truck, portions of the truck being cut away to enable the motor to be more readily seen. The motor is entirely water and dust tight, the only opening being the lid over the commutator, which enables the two brushes to be easily reached. The frame is in two parts and made of steel. The gear housing and commutator lid are of malleable iron. Both gears and pinions are made of steel. The shaft is large, being $3\frac{1}{2}$ inches in diameter, and $2\frac{1}{2}$ inches in the bearings. The bearings are very long, and arranged for thorough lubrication with grease. The efficiency of the motor is 90 per cent. For the better understanding of the flexible support and other important points, detail drawings are shown.

The diagram, Figure 2, is an end elevation of the motor, with one wheel removed. *B* is a cast-iron **U**-shaped frame, the rounded end being journaled on the car axle in the ordinary way. Swinging freely between the arms of this frame is the motor *A*, trunnioned by its bearings, but not touching the axle. The motor is then supported at the rear by spiral springs *C*, between lugs on the frame and the arms of the **U**, and at the front end is supported by a swinging arm from the ordinary spring truck bar *D*. It can be seen that with this suspension, the motor rides freely on springs, readily adjusting itself to varying conditions without bringing a strain or shock on any part. The gear centers are always maintained because rigidly connected by the framing.

Figure 3 shows how the lower half of the motor frame swings downward while the armature remains in place, one man being able to let it down and replace it after inspection and cleaning. The armature may be removed, if desired, from below, or if the motor should not be over a pit, the upper half may be swung up and the armature removed from above. By referring to the figures it will be seen that all the bearing caps come off from below, and all the bolts pass down from above; and, should a nut come off, no part of the motor can fall. The bolts do not sustain the weight of the motor, and the nuts are all locked with pins."

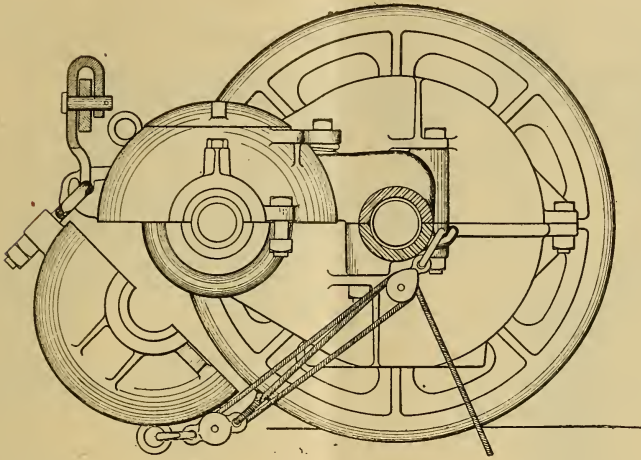


FIG. 3.

The continual reduction of weight in proportion to power has been a principal mechanical feature in street railway motors. One horse power transmitted with 48 pounds of weight where 100 pounds were required but a short time ago, is certainly progress. Another feature to which attention may be called, is that after exhausting all kinds of ingenious expedients for reducing motion, the end seems to be found in well-made simple spur wheels ; just what inference pointed out from the beginning.

There is a strange prejudice against tooth wheels, mainly caused by the imperfection of rough cast ones, but the fact is that such wheels are among the most perfect and durable of machine elements. The Walker Manufacturing Company make a specialty of wheel gearing, both cast and cut.

MINERAL STATISTICS, 1892-3.

The publishers of the *Engineering and Mining Journal* are now engaged in preparing a new volume of Mineral Statistics for 1892 and 1893, which will be a quarto volume so as to admit of more complete arrangement of tabular matter. The compilation of such a volume, as the publishers claim, is a work of greater magnitude than any other of the kind ever undertaken by a private firm, and will be of corresponding value.

The work will embrace new mineral substances not before reported, and the make-up will naturally be an improvement on the

first volume issued in 1893, that covered the whole period of available history in all mineral producing countries. This first volume has become a most valuable reference, and will remain so, but of course applies only down to the close of the year 1892.

The Editor has kindly sent us an advance summary, from which we select a few items as follows, giving only the columns of values :

Product.	Value at Place of Production.	
	1892.	1893.
Aluminum, value at N. Y.....	\$191,750	\$202,800
Copper, " "	36,716,400	34,677,940
Gold, coining value.....	32,997,071	35,950,000
Pig Iron, value at N. Y.	134,668,035	93,888,309
Lead, " "	16,450,400	14,467,029
Quicksilver, value at S. F.	1,119,720	1,108,527
Silver, coining value	84,038,500	78,220,450
Tin	29,827	
Zinc, value at N. Y.....	7,785,993	6,214,782
Asphaltum and Asphalt Rock.....	254,016	174,720
Cement, hydraulic	5,999,150	5,180,797
Coal, anthracite.....	89,727,982	93,091,670
Coal, bituminous.....	124,230,532	118,594,834
Coke.....	23,421,117	14,688,495
Petroleum	30,229,128	30,223,505
Salt.	5,900,000	5,717,743

The price of Vol. I is \$2.50, and of Vol. II \$5.00.

The new pumping engine at Milwaukee, and the Sulzer Brothers engine at Moscow, have caused the leading makers in this country to hunt up their records. Messrs. Fraser and Chalmers, of Chicago, send the particulars of a vertical triple engine of theirs, working in the De Beers mines at Kimberley, South Africa, consisting of a report by the manager, showing a consumption of 13.5 pounds of feed water per hour. The engine has Corliss valves and all improvements known to modern high-class practice. Bids were invited for this engine from fourteen makers in this country and Europe, under certain stipulations laid down, among which was a guarantee of feed water consumption, not exceeding 14.5 pounds per actual horse power per hour, and a forfeit of £200 for each quarter of a pound more consumed. Out of the fourteen firms and companies, only two dared to undertake the work and assume the guarantee. Of these two Messrs. Fraser and Chalmers were one, and the contract was given to this firm with the result as above indicated. A similar engine is now being erected at Salt Lake, Utah.

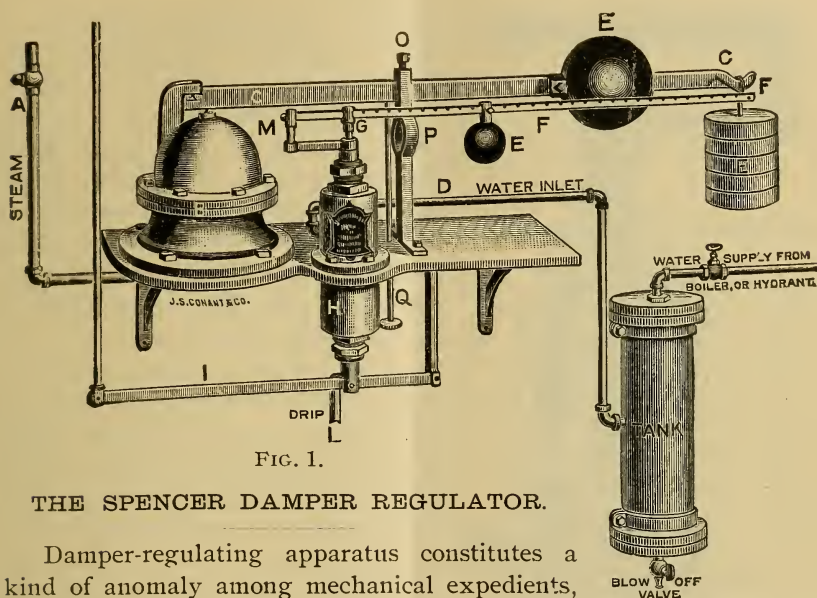


FIG. 1.

THE SPENCER DAMPER REGULATOR.

Damper-regulating apparatus constitutes a kind of anomaly among mechanical expedients, its use being apparently inversely as there is requirement for its work. On this Coast where the price of fuel is high, and its economy, as one would think, a first consideration, fire regulation is commonly performed by a shovel, and its regularity contingent upon the industry of firemen. In other sections of the country where fuel is cheap automatic damper apparatus is employed generally. These regulators have been produced in a great variety of forms, all controlled, however, by the variation of steam pressure acting either on diaphragms or pistons, generally the former, which is the more simple, but lacks the required range and power to operate dampers, unless the latter are mounted in a very sensitive way.

The device shown in Fig. 1 is a new modification, wherein a separate hydraulic cylinder is employed to perform the work of moving the damper, the variations of boiler pressure performing little more than indication.

The pipe *A* on the left extends to the steam boiler, and establishes communication with a flexible diaphragm in the joint at *B*. Resting on this diaphragm is the second fulcrum of the large lever *C*. The weight *E* is adjusted so this lever when in a horizontal position will balance the required steam pressure. Connected with this lever, and having coincident movement at its outer end, is another smaller one *F* that operates a small distributing valve for the hydraulic

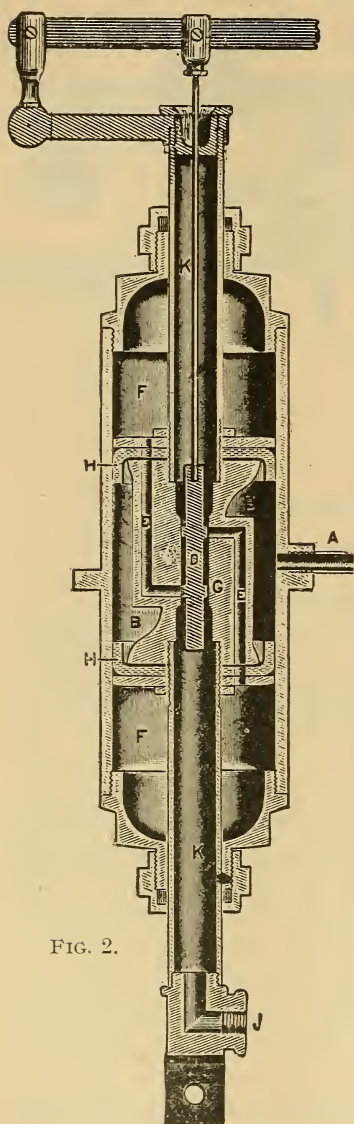


FIG. 2.

cylinder *H*, the piston of which moves the lower lever *I*, connecting to the damper by the vertical rod on the left.

The hydraulic cylinder *H* is connected by a pipe *D* with the water space of the boiler, or any other source of water under pressure, the tank on the right being to catch impurities and reduce the temperature when hot water is used. The construction of the hydraulic cylinder *H* is shown in the section Fig. 2. In this cylinder is a long piston having right and left cup packings *H H*, and hollow piston rods *K K* extending through glands at the ends. Around this piston is an annular chamber sustaining static pressure from the pipe *A*, and in the center a small piston valve *D*, moved by the lever on top that distributes the water above or below the main piston through the ports *E*.

The main double piston, the hollow piston rod *K*, and the lever on top, all move together, but as the outer end of the lever is connected at *F* the distributing valve does not follow the main piston, but is overtaken, and the water cut off each way, like the steam or hydraulic steering gear of a ship, in other words, referring to Fig. 1, the lower lever *I* follows the upper lever *C* with an increased and powerful movement not dependent upon the diaphragm at *B*, so that when ad-

justed the damper will open and close with a variation of one pound to the inch of steam pressure.

The mechanism is extremely ingenious, and as there is no metallic water or steam joints the apparatus should be durable. Mr. A. N. Lewis, the agent here, sends us a list of a large number of places where these regulators are in use in this City, and elsewhere in the State, with evidences of very successful performance.

LITERATURE.

The Argentine Republic. **Bureau of American Republics.** DEPARTMENT OF STATE, WASHINGTON.

This Bulletin is thoroughly business like, containing a great deal of commercial information, but its principal feature is a compendious history of the Argentine States.

Just now this large country is best known by the unfortunate speculations of four years ago, when the country went through what is called, in modern terminology, a "boom." Since then the efforts of the people have been directed to mending in various ways the baneful effects that are always a sequence of inflated prices.

Buenos Ayres, the capital and chief city, was founded in 1580, 314 years ago, and now contains 600,000 inhabitants. The Spanish occupancy during 200 years was characterized by features with which we are familiar on this Coast, ending in war, conquests, reprisals and a continual shifting of boundaries down to a period within the present century, when "cosmos" began to come out of chaos, and European capital commenced to flow in, and finally "flowed over."

We can well remember, twenty years ago, of seeing a whole fleet of fine steamers lying idle in a dock at Birkenhead, in England, built for the South American trade. The country went wild over South America. Millions of pounds sterling were loaned on the bonds of the different South American States, resulting finally and recently in the collapse of the great firm of Baring Bros.

The English people have a large investment in these countries, which the writer in the present bulletin does not mention, and which is now, and must remain, the main cause of British trade connections there.

The mines of the country are, no doubt, to be a principal industry, especially when the railway across the Andes has made the interior mountain regions accessible.

Under the head of Mining Laws of Argentine we find the following note:

"Mr. Garrison says that near the town of La Rinconada there is a vein of aurifer-

ous quartz two miles long and four feet wide, running from northeast to southwest, from which a large quantity of gold has been already extracted, and which when worked at the depth of 500 or 600 feet could yield sufficiently to give occupation for half a century to 5,000 laborers."

Spon & Chamberlain's Practical Hand-Books.

The firm above named have commenced the publication of a series of hand-books devoted to various technical pursuits and branches thereof, issued at one dollar each, five by six inches, and well bound.

Series of the kind, beginning with Weale's thirty or more years ago, have done a great deal of good in an educational way. Some more pretentious efforts, like the science series, overshot the mark, not for the circumstances of twenty years ago when discovery and change was less, but for these times when a new edition every year would scarce compass the requirements.

In the present case the series are large enough and cost enough. Of course the greater part of the matter in some of the books, and all of it in others, may remain permanent, but the "up to date" requirements of the times call for revision and new editions that cannot be afforded with large books.

The two books now at hand are on "Magnetophone Hand Telephones" and the "Management of Engines and Boilers." The title says "run" engines and boilers, but our aversion to the term causes it to be "skipped" in this and all other cases.

The last-named book is a well-known one, by our friend and colleague, Mr. E. P. Watson, of the *Engineer*, and is, of course, intensely practical, and didactic in style, containing a large amount of useful information for marine and other engineers in actual service.

The book on telephones makes the whole matter "as plain as a pike staff," an implement of extreme lucidity, at any rate we would not have the least reserve in setting out to make a telephone with the aid of the book.

LOCAL NOTES.

In the present number of *INDUSTRY*, and consecutively in several future numbers, will be published an essay on Centrifugal Pumps. The suggestion came about by continuous inquiry respecting literature on this subject, and the fact that there was none that could be referred to. These articles were undertaken under some temerity, because it was necessary to ignore, and, in many cases, controvert assumed data for constructing such pumps, but there was the support of makers who vigorously denounce existing rules and computations, as well as the results of many experiments, as "humbugs," and certainly there is room for this. In the present articles there are, no doubt, errors of conclusion, but the grounds of treatment are tolerably firm, being from actual observations and experience in constructing these pumps for a variety of purposes here in California, and in watching practice elsewhere. Something, too, is assumed from a belief that nowhere else has there been so much learned by actual experiment in centrifugal pumping as on this Coast.

Prof. C. A. Stetefeldt, the well-known mining engineer of this City, has for the present given up smelting, roasting, reduction, assaying, and other metallurgical pursuits, for more attractive and less responsible research in speculative philosophy, ethical and physical, and has recently read a paper before the the Astronomical Society of the Pacific Coast in answer to the problem: "Can Organic Life Exist in the Planetary System Outside of the Earth?" Professor Stetefeldt is an intensely practical man, who has persistently supported the teaching of natural sciences in our schools, colleges and universities, so in the present instance has, so far as possible, confined his essay to scientific premises, here and there introducing formulae, and winding up with a comparative table of the "physical qualities," so to speak, of the planets. A copy of the paper, which has been printed in pamphlet form, is sent for review, and the circumstances suggest irony. How are we to know anything about planets millions of miles away, and whether the opinions here expressed are tenable or otherwise? There is nothing to be done but accept the author's views, which we do cheerfully, and even confidently. The paper is rational, readable, and we hope true.

The Abner Doble Company, of this City, who have been extending their engineering and machine department, have selected a line of work suggested by the circumstances of our time ; means for transmitting power, meaning thereby transmission by electric, hydraulic and pneumatic apparatus. The Company contend that circumstances call for all these methods, and that there are in all cases reasons why one method is right and another wrong. It goes without saying that the main elements of transmission are cognate in nature, and a great deal of the data required for such undertakings is common to various mediums. Mr. Chodzko, who prepared the articles "On Power Transmission" in our May and June numbers, is on the staff of the Company, and we think that some of the first efforts could well be expended in this City, the most promising field possible, and at this time singularly wanting in distributed power, except that furnished by the electric companies.

Speaking of power transmission, the Pacific side of the country here is the principal field on this continent for such enterprises. The slope is short and abrupt, consequently distances to the sea are short. The climate is genial, and the natural environment all that can be desired. The time may be long, but the day will come when the immense volumes of water, descending thousands of feet within short distances down to level areas extending to the sea, will determine the industrial interests of this region. This kind of prophecy is easy, and, as one will not be held responsible for its fulfillment, we may also predict a time when manufacturing interests will flourish here. The main element in manufactures is some one to sell to, the next a population and physical conditions that permit skilled industry. Just now the market is closed by restrictive laws, here and elsewhere, that prevent trade. Our Eastern friends with a wide home market can organize and centralize manufactures, and produce so much cheaper as to meet the cost of transportation from there. This Coast is now, no doubt, at the lowest point in its industrial history.

The rains in this section of California during the first days of June afford another instance of the inconstancy of weather phenomena, also show how vegetation has by evolution and selection adapted itself to the dry season. The rains have done but little good compared to the harm, if all crops are considered. There is a

forcing of fruit growth that will lead to loss, and the cherry crop is nearly ruined in a most singular manner. When a drop of water gathers at the bottom of the berries it has some weakening effect on the skin, or by expanding the pulp, the cherries split open, and are destroyed for any use but immediate packing. The California native grass resents such irregular procedure, and dries out at a more rapid rate, with a good share of its strength soaked out. A rain in June that would in the Eastern States be hailed as a blessing, and add millions to crops, is here not wanted, and does injury.

The great sewer at Los Angeles, Cal., now completed from that city to the ocean, is a very creditable work to be carried out by a city so new and with a population of less than one hundred thousand. The sewer is about 13 miles long, constructed in ten sections, some of brick, some of redwood, and a portion open cut. The last section is of cast iron 24 inches in diameter, 1,200 feet long, reaching 600 feet out into the sea where the water is 20 feet deep. The brick sections cost about \$6.00, the wood sections only \$2.25, and the iron \$8.33 per foot, the whole work reaching the sum of \$260,000. This settles the sewage problem in Los Angeles for a long time to come, and was a work that could not well be avoided in that progressive city. The work was carried out by the city engineer, Mr. J. H. Dockweiler, C. E. There is a large suggestion in the comparatively low cost of the redwood pipe, and the life of the sections thus made will be watched with interest.

The Napa Valley, leading out northwest from the head of San Pablo Bay, affords some striking phenomena in geological structure. On the western side the formation is sandstone covered with strata that if not old in a geological sense has the common characteristics of the general surface of the Bay country, but the eastern side is a pile of volcanic lava, ashes and tufa. It is like the rim of a crater for thirty miles or more. The distance across the valley narrows in some places to a few miles, but the characteristics named continue, and the problem arises whether meteorological influences can have much contributed to this strange diversity. The influence of winds is of course much more on the eastern side, and has, no doubt, kept the eruptive matter bare, but there is some greater cause than this. In places near Napa, fifteen miles or so from the

Bay, the earth bears every resemblance to an old slag pile from a smelting furnace, consisting of mingled ashes, scoria, basaltic and other heterogeneous elements.

A large water-power plant was finished a short time ago by the Pelton Water Wheel Co., of this City, for a mining company near Barberton in the Transvaal, South Africa. Water is obtained from the Queen's River, 2,000 cubic feet per minute, with a fall of 150 feet. The company that erected the power plant own a number of mines within a radius of four miles, and will distribute the power by electricity. The Pelton wheels, four in number, are six feet diameter, run at 150 revolutions per minute, driven by single nozzles $4\frac{1}{4}$ in. diameter. Each wheel drives a dynamo by means of five cotton ropes $1\frac{1}{2}$ in. diameter. The pipe line tapers from 30 inches at the inlet, to 26 inches at the wheels. The company have a constantly increasing business, and just now are fortunate in having foreign orders to occupy their facilities.

The Editor having run out of fish stories, supplements the following: In his garden, planted there by a former proprietor, are some magnolia trees that are fifteen or more years old, and about twenty feet high. A blossom now at hand measures on its axis six inches, and the diameter five and a half inches, and it is not a very good year for magnolias either. The present flower is not exceptional, there are many more of equal dimensions, and one can hardly recognize them as the same aromatic blossom sold on the Washington trains at Annapolis Junction, seldom more than two and a half inches in diameter and flat, the cubic measure being one fifth or less that of the present example. We caution our friends against going into the culture of these trees unless they are young people, and have aqueous land on which to operate. Flowers cannot be expected in less than ten years, and the water should come within a few feet of the surface of the ground and stay there.

COMMENTS.

In the notes of *Cassiers Magazine* it is stated the sand-blast patents of Messrs. Tilghman have expired, and it is a wonder others do not make such apparatus, also that the technical information respecting the matter seems hard to arrive at. Perhaps we can add some. In the first place the patents have not run out, and are not likely to do so; one of the most important dates about 1885. The sand blast, and other processes for cutting and abrading hard material, have undergone an evolution at the hands of General B. C. and his brother, R. A. Tilghman. They have spent thousands upon thousands of dollars that a manufacturer would not think of doing. They are scientific men of extensive means, who have added to the wealth of this and other countries hundreds, if not thousands, of dollars for every one gained by them. Modern methods of distilling fatty material into fat acids, glycerine and stearine, is one of their contributions, over which their expenditure in defending patents must have reached \$150,000 at least. The sand blast is going on, and it will be a vigorous competitor who will expend what Messrs. Tilghman do in improving the various processes. It would require what they maintain, a physical laboratory, a large works, and an inquiry into each and every fact bearing upon the subject of abrasive cutting all over the world where the arts are carried on. Gen. B. C. Tilghman is now in this country after an absence of many years, and a visit to the works and laboratory in Philadelphia would find him assiduously engaged in solving some problem in science or the arts. Reverting again to the sand blast, the scope and possibilities of this strange process are by no means exhausted. It is being slowly and carefully developed, and has never been the subject of sensational procedure. The failures and abandoned machinery and processes in this business would make a book, a large one. It is not a safe thing to "tackle," and will not be for a time to come, unless there is a fortune to be expended by the experimenter.

There is now before the Immigration Committee of Congress, a Bill in which it is proposed to make it a misdemeanor punishable by a fine of \$300 to \$500 for any one to employ deckhands or sailors for the Lake service unless the persons employed have been permanently

in the United States for six months previous. This looks all right and to be good "protection," but the method is not quite right. Instead of forbidding the employment of aliens, their wages or a portion of them should be forfeited to the Government for revenue. This would be consistent. If these aliens resided on the Canadian side and sent the products of their labor here, the purchaser would have to forfeit 40 per cent. or more in customs tax, and there is no inconsistency whatever in applying the same method to a man who will import his labor here "all in a bunch," at one time. The strangest part is, however, that vessel owners on the Lakes do not like this proposed measure, because it will raise wages, which we are told is the very object of trade restrictions of this kind.

The fair commercial name of Holland has been stained by swindlers, who steal the livr y of heaven to serve the devil in. Orders are sent to this country, and to others no doubt, for goods to be shipped to certain firms of ill repute, or no repute in most cases, because non-existent. It is a kind of swindle not new in Continental Europe, and is well understood in England, so well indeed that some of the principal engineering firms refuse to let salt water come between their goods and the money paid for them. This does not mean that foreign orders are refused, but that such orders are turned over to merchants and shippers to be filled. Indeed it is unusual to order direct from manufacturers or makers for foreign trade. It is not the cheapest and best way. There are large responsible firms, especially about Liverpool, who buy on foreign account, pack and ship goods. Such firms know all about the laws in various countries, have correspondents in all centers of trade, and do their business for a small uniform commission.

Those of our Pacific Coast millers who have attempted to find a market for wheat flour in Central and South America, or in Mexico even, must have met with some new views respecting the beneficent effect of customs tax on this commodity. At Chihuahua, Mexico, the duty on flour is 4 cents a pound; at Mazatlan, where the merchants of San Francisco do a good deal of business, the duty on flour is \$97.00 a ton, nearly 5 cents a pound, or \$10.00 a barrel, and the freight there \$1.00 a barrel. In the City of Mexico the duty on American flour is 10 cents per kilogram, or about 4½ cents per

pound. In some of the Mexican towns the consuls in reporting upon the chances of selling American flour do not mention the tariff rates, but only say they are "prohibitive." In Guatemala the duty is \$5.35 in silver, or \$2.65 in gold, per barrel. In Honduras there is no duty. In Bolivia the duty on flour is about 60 cents per 100 pounds. In Colombia the duty is about 2 cents a pound, in Ecuador 1½ cents a pound, and in Venezuela is \$5.25 per barrel more than the flour is worth.

The Carnegie armor-plate fraud, now being pretty well established as a fact, we have not before alluded to, and now only want to point out the difference between the "line" and the "staff" in the matter of inspecting such work. The Government send line officers to the various works where war material is made to inspect and pass it. The Bureaus of Construction and of Steam Engineering also send officers to inspect and receive material and work on behalf of the Government, but these last are staff officers, and herein lies the difference. With some knowledge of the manner in which this last-named business is conducted, we will wager that the whole amount of bad work passed by the staff officers of the Navy would not amount in value to one of the bad plates reported to have been sent out of the Carnegie works. The staff work is done conscientiously and completely, even hypercritically sometimes, and in a manner that would cause surprise to those who suppose that constructors and engineers go about in uniforms and gloves.

The Carnegie Company have contracts with the Government to furnish 3,000 tons of armor plate, not counting holes. The price is about \$5,000,000, and the profit, one may well suppose, adequate if not more, and faulty work in this case is the most unpatriotic act that could be imagined. Mr. Carnegie's Scotch shrewdness has enabled him to use the American protection policy, in conjunction with "soft sawder," as Sam Slick calls it, to his enormous advantage. His Triumphant Democracy, which we once tried to read, is nauseating to anyone not blind to its inaccuracy of statement and fulsome flattery. One of our contemporaries points out how Mr. Carnegie had an interview with President Cleveland after his Company had been cast in damages amounting to \$280,000, and how Mr. Carnegie secured a remission of one half of the amount.

Some of the testimony given in this Carnegie matter, if it be true, and there seems little reason to doubt it, shows very careless practice on the part of the company, as well as ignorance or connivance on the part of inspecting officers. Bad steel plates might be made by the exigencies of a new and difficult manufacture, but making screw bolts does not come under that class, and the testimony of one witness goes to show that the methods in the screw-bolt department were such as would not be tolerated or thought of in a junk shop. There is no doubt a want of good mechanics around large iron works where finishing processes are a minor branch, and are turned over to low-priced and incompetent men. It would shed some light on this matter to know the amount of wages paid to the men who make armor-plate bolts in the Carnegie works.

Comments in the newspapers respecting a tariff on sugar shows how far public opinion can reach in such matters. Under the late tariff act sugar was made free, no custom tax being imposed, and this seemed to be a concession in favor of consumers, but when the matter is examined a little more closely it turns out to be something else. The free importation related to what is called brown sugar, at least that was and is the only kind imported in this country, but there was a stiff duty imposed on "refined sugar," so the act was to put money in the pockets of the sugar trust, and extract it from the sugar consumers. This does not seem much of a problem, and would not be in most branches of human learning, but we doubt if one person in twenty in this country understands the objects and nature of free brown sugar. To compensate for this a bounty was and is paid to the makers of sugar in this country, which in the case of beet sugar culture may do some good, but not in cane sugar culture. It is a forced business, not profitable, because the crop must be planted each year instead of three or four years, as in Cuba and other tropical countries.

To the discussion now going on in respect to the suggestion of the Commissioner of Patents that those acting as patent agents should be qualified to practice in the Circuit Courts, we have but one remark to offer, and that is that the Commissioner of Patents has certainly not considered, or taken into account, that among those admitted to practice in the Federal Courts not one in ten is trusted with the conduct of patent cases tried in these courts. The

draughting of specifications, and dealing with references that may arise in procedure, may, in a sense, but only in a limited sense, involve problems of law, and these when required are very fully "taken care of" by the officers of the Bureau. Procedure in patent soliciting is a technical pursuit that should be coupled with a control of language, an understanding of the arts, and an acquaintance with the brief and simple laws relating to letters patent. Court procedure is quite another thing. There is no objection to a patent agent being a lawyer, but how he is to learn the law and also the much wider field of construction and technical art is a problem.

Mr. William H. Webb, whom our older readers will remember as a great shipbuilder before the days of steam, has founded a home and academy for shipbuilders, a most commendable undertaking, to which he has contributed \$2,000,000. Technical people, to use a general term for the skilled in mind and hands, are singularly behind in means of looking after worthy indigent people of their callings. None need it more, and none deserve it so much. We know just now of a most worthy man over eighty years old, whose contributions to the wealth of this country can be counted in millions, seeking a place in the "Mechanics' Home," at Philadelphia. We do not know what this home is, but it is the only mechanics' home we have heard of. More such institutions, and less universities and colleges, would be a worthy change for a time.

Mr. E. L. Godkin, writing in the *Forum* for June, in answer to the query, "why does not the working man have more money?" says:

"The answer is that he gets now all there is for him, and that, if he is to have more, it must come from some great and sudden increase of production unattended with a great increase of population. The income of this and every other country in the world, since the plunder of foreign nations has ceased, is the product of its land and labor. Some of this income goes to pay wages.

Here at this day, we have the old illusion of a wages fund provided out of capital. We would like to see Mr. Godkin find this fund in the accounts of any manufacturing firm or company. The money paid for wages is converted into merchandise and the merchandise is not paid for until it is delivered; so the fund required for

wages is at most what will bridge over the period of making sales. Suppose for example an employer of labor at the beginning of a week or a month takes an inventory of his assets and at the end of the time makes another inventory, what will it show? Simply that he has bought merchandise or the product of labor to the amount of wages paid out and has a balance over, equal to his expense account and profit. Wages produces itself and requires no fund, and no such a record can be found in account books properly kept, except as before said, "money" may be required to pay for merchandise or product between the time it is completed and sold. A "wages fund" is a fallacy.

A suit brought by the Gates Iron Works, of Chicago, against Fraser & Chalmers, of the same City, has ventilated, so to speak, a number of patents pertaining to gyrating crushing machines. The first suit was brought in the U. S. Circuit Court in 1890, and the complaint was dismissed at the complainant's cost. Appeal was taken to the U. S. Supreme Court, and was decided in May last, affirming the action of the Circuit Court. The evidence in these cases was voluminous, and, without attempting to say more, our conclusion is that there is not much covered and protected by the patents on this class of machines, the reason being, no doubt, that the makers naturally, and consistently too, attempted to patent all the small improvements as they went along, but not any essential feature or element. These two large firms have disbursed a good deal of money in this long litigation, much more, no doubt, than the equities involved.

There is a good deal of discussion over the policy of England in discontinuing silver coinage in India. This discussion is mainly in this country, and is, of course, in ignorance of the theory on which that policy is based. It is true that the present effect in England is bad. Whatever embarrasses or causes losses in other countries must cause losses in England by reducing the volume of trade and diminishing the value of securities. The English financiers are by far too astute to have overlooked the main results of their policy, and there was evidently some object not understood by people outside. One purpose may have been to call out a large amount of gold that is dormant in India, and this process is now going on. When one rupee in gold will buy two in silver it will not be long until all the

gold is in circulation, and not very long until it is all in England. There are no ethics for commerce, except to meet assumed obligations, and when our friends rail at England for "collaring" the gold of the world by their free-trade policy, it is well to remind them that this same object is what the rest are striving for.

The most logical charities that have been announced in these times are pawnbrokers' offices in New York that lend money up to a safe point on goods, and charge a reasonable interest; also, in the same city, dispensing stores where fuel and food are sold in small quantities at wholesale rates. As a rule a poor man pays a double profit, if not a double rate, for a good many things he consumes. The rich man borrows money at four per cent., the poor one at twenty-four per cent. The rich one buys coal at \$5.00 per ton, the poor one at \$10 a ton, and so on through various necessities and wants. By using capital at no loss, or even at a small profit, one can put the necessities of life within the reach of poor people at two thirds the rates they usually pay, and without any risk of misappropriation of the charity thus bestowed. It is not charity altogether, but justice, and we hope to hear a good deal more of this kind of aid.

ENGINEERING NOTES.

Two more fly-wheel accidents, one at Pittsburgh, and one at Montreal, bring to mind the fact that if anyone looking at a large engine in motion stops to consider that the only thing between normal working and destruction is a leather belt or some other tackle of transmission to a governor, they would feel like "moving on." It seems a criminal risk to run, and is so. This is the nervous point with steam engineers who have charge of such machinery. It is a continual dread. "What if the engine gets away?" is present in mind all the time. A second governor attached directly to a trip throttle valve would be a small matter to add to expensive engines, and would afford almost perfect security against a runaway. As soon as the emoluments of this Journal permit, we will buy an engine and will have made the first thing a safety governor, then one for regulation, and finally an engine to fit these.

Professor John E. Sweet, in a recent letter to the Editor, brings to mind the old adage of learning being a dangerous thing. He says: "I am fast learning what a bad engine I am making." Now it is a matter of common knowledge that there is not in any works in this country more precision bestowed on engine fitting than in the "Straight Line Shops." Every friend of the Professor's knows what he means, namely, that his ideal lies far beyond what can be attained in good fitting and precision. The limits of good work are commercial in nature, especially at the present cost of precision, which is no doubt a double price, because the art is new. It is not 45 years since Sir Joseph Whitworth, in Glasgow, exhibited his surface plates so true that one would lift another by flat contact only, and the era of exact tools for ordinary purposes is within a quarter of a century. Professor Sweet should go out for a while among the country saw-mill shops and "even up."

One of the vagaries of engine practice is seen in what are called slipper cross-heads for high-speed engines. These cross-heads have their mass at one side of the rod or line of motion, and the result is much the same as a bending blow of considerable force at each end of the strokes. This force is computable and astonishing, still it seems to be disregarded, especially in England, for both land and marine engines. The conveniences and symmetry of construction may in some cases demand that cross-heads be unbalanced across the axis of a piston rod, but the weight of the "overhang" should be as little as possible, and the rod made correspondingly larger to withstand the bending strain.

We will venture the opinion, based on the analogy to sails, that flat vanes are much less efficient than curved ones for windmills. A cycloidal curve is no doubt the correct one, and the subject can be mathematically treated, but, as before said, judging by analogy, only low efficiency can be expected with flat vanes. At first thought it will seem that the course of the wind should be reversed, or brought to complete rest, as the water is in a turbine wheel, but the conditions are different. The water is discharged into the air, a light medium offering but little resistance, but the spent wind must be discharged into the same medium flowing in the same direction. Discharge must take place, therefore, at some angle within 90

degrees of the course. In California, for house pumping or other light work, the manufactured wheels do very well, but for large powers, which seem wholly feasible here, the best effect will be gained by sails, that can be mounted for the Summer season and then stored away during the storm period.

There is strong indication that the "laws of friction," as laid down in the text books, will soon need amendment, if not a new code altogether. In a recent work, "A Manual of Hydraulic Engineering," there is direct issue taken with the laws of friction, argued mainly in respect to fluids moving on solids, which we suspect, however, is not contemplated in the laws of friction as commonly applied. The following are the rules or laws referred to :

1. The friction of any two surfaces, whether of quiescence or of motion, is directly proportional to the pressure or force with which they are pressed perpendicularly together.
2. Friction does not increase with the increase of rubbing surfaces so long as the pressure remains unchanged.
3. The friction of motion is wholly independent of the velocity of that motion. The co-efficient of friction is the same at all velocities.

The want of confidence in these rules arises from the extremely varied circumstances under which friction is developed, and its equally variable degree. It may be noticed that the rules above given afford no information whatever of practical use, that is, do not give a measure of friction or means to avoid it, only express conditions of friction, and these questionable, except as to results obtained by laboratory experiments.

Improvements in elevators, or "lifts," as they are called in England, have there a characteristic of ponderosity, and also a feature of being behind the times, except as to safety, and this one must admit is not a small matter. The latest invention given out in a public way is a triple cylinder machine, so arranged that when the water is turned on, a centrifugal governor determines how many of the rams or pistons are called into play. The scheme seems a strange one because the element of speed is made the regulating condition. The greater the load the less the speed, and *vice versa*. It is at least eighteen years since this system of several cylinders and pistons was introduced here, and a good while since they were supplanted.

Makers of elevators in this country manage to use power in proportion to work, without such expensive contrivances, balance the cages or dead load without weights, and otherwise have abandoned many of the features of common practice in England.

ELECTRICITY.

NOTES.

Electric smelting of metals comes as near being a profound mystery to the public as any matter that can be named. Dr. Laval, of Sweden, who has recently patented in this country some improvements in this process, gives some explanation of the matter in his specification, as follows:

“In the present method of smelting or heating iron or other materials by means of electricity, the heat requisite for the smelting is produced by conducting an electric current through a layer of molten material of slight conductivity—an electrolyte—which, owing to the resistance offered by it to the electric current, is heated so greatly that the metal, which in the case of iron, is supplied from above, and owing to its greater specific weight, sinks through said layer, obtains the temperature required for the smelting during its passage through this layer. The two pole pieces are inserted in the furnace at each side of a transverse bridge, made of some refractory material, and under the electrolyte, so that the current must pass above or beneath this bridge and through the electrolyte, in order to go from one pole to the other. As these pole pieces are situated under the molten layer of slight conductivity they will, during the process, become slightly fused so as to be transformed in the molten metal. As the pole is usually reckoned up to the point of contact between the metallic conductor and the electrolyte (in this case the layer of slight conductivity) the two poles will thus in the present method consist of molten metal.”

The American Society of Electrical Engineers have practically set at work a scheme that has often been considered on this Coast, of founding “sections” or divisions of the leading technical societies at distant points, where papers presented at the principal meetings could be subsequently discussed in the auxiliary branches. Of this scheme Mr. R. W. Pope, Secretary of the American Institute of Electrical Engineers, in a recent letter says: “The experiment of discussing the monthly papers in the two cities has proved successful beyond the expectation of the most sanguine, and will, no doubt, become an important feature of society practice. Three of these

auxiliary meetings have now been held in Chicago, the last being the most successful of all in points of attendance and enthusiasm." The membership on this Coast, which the Secretary says is fast increasing, should soon enable auxiliary meetings to be held here. It is a method that admits of wide extension in the case of various organizations of the kind.

Mr. O. M. Rau, in *Cassiers Magazine* for June, 1894, says of the overhead trolley system for electric railways: "A point of perfection has been attained, where it is safe to say no radical improvement will follow, and a system constructed on the standard of to-day, will not be much out-classed by future construction." This is comfortable assurance, but is not wholly novel, similar prophecy is not unusual, indeed is common with sanguine inventors, but what Mr. Rau means by improvement is not quite clear. If he means the commercial cost of a railway line irrespective of other considerations, he may be right, but there is another side to the problem. People do not seem to be carried any cheaper on a trolley line than by cable lines, or steam lines, consequently the satisfaction to be derived from the view above, must pertain to the stock-holders.

That Mr. Rau's dictum will not be accepted by the public, is sufficiently shown by a great amount of effort now going on to improve on the trolley system of electrical propulsion, not with respect to the cost of construction, but in some other matters of greater public concern. This matter of economy from the owner's view, is the subject of various discussions. In late numbers of the *Railway World*, London, is a long essay on "The Relative Economy of Cable and Electric Tramways," in the whole of which so far as we have read there is not a word respecting the amount collected for hauling people, public safety, convenience or any other matter, except as to cost of service. We perhaps have no reason to expect more, but there is certainly wanting a good deal of literature from the other side to balance up the discussion.

The Field family, five of them, otherwise the "Electric Railway Company of the United States," have ventured into court with their patent, No. 407,188, and got kicked out as was deserved and expected. A suit was brought against the Jamaica and Brooklyn

Railway Company, in the United States Circuit Court, Eastern District of New York, for infringement of the patent granted to Stephen D. Field. The first claim of this patent reminds one of the celebrated claim on the sporting dog attachment, which ends with "also the whole dog." The first claim in the Field patent reads as follows :

"Claim.—1. The combination, substantially as hereinbefore set forth, of a stationary dynamo-electric generator driven by a suitable motor, a circuit of conductors composed in part of an insulated or detached section of the line of rails of a railroad track, a wheeled vehicle movable upon or along said insulated section of track, an electro-magnetic motor mounted upon said vehicle for propelling the same and included in said circuit of conductors, and a circuit-controlling device placed upon said vehicle."

The following, from the *American Engineer*, indicates a very sensible conclusion. If conduit conductors for railways are practical let us know it.

"It is reported that the Metropolitan Traction Company, of New York, are to make a trial of the Siemens-Halske system of underground electric trolley line in New York. The system has been in use successfully for some time in Buda-Pesth on several lines, the first of which was laid down in July, 1889. This system is of the simplest construction, consisting of a conduit of pear-shaped section with two angle irons on one side, one for the in-going and the other for the return current. Sliding contact is made by means of shuttle-shaped sliders. Sixty cars are now run over the lines at Buda-Pesth, at an average speed of 12 miles an hour, and at a cost of 5½ cents per car mile. It would thus seem that this system has demonstrated its practicability at Buda-Pesth, and it remains to be seen if the conditions at New York would militate against its success there. It may be noted that in a report of the United States Consul at Buda-Pesth, made about a year ago, it was stated that the operation of the road was several times interrupted by unusually heavy falls of snow, though otherwise its operation was declared successful."

MISCELLANEOUS NOTES.

There is just now a dearth of what may be called the mechanics of mining. There is plenty of news, but the spirit of invention and change is quite dormant, hence a paucity of matter in our notes. For one thing, the Johnston concentrator seems to be very successful, and there is no doubt a special effect by the peculiar undulating movements of these machines, produced by what the inventor calls

“non-parallel links.” The pivoted links or struts, as they may be placed below or above the table, are so arranged as to give a movement like that of the hand *batea*, which all admit to be the most perfect of all expedients for washing and concentrating. There are a number of other points in these machines that contribute to a greatly increased capacity, and a large number have gone into use during six months past. They are made at the Risdon Iron Works, in this City.

Considering the matter of recent floods in the North Western and Eastern districts of this country, the results have been deplorable, and there seems no remedy for the future. People will crowd streams beyond the danger line, because the rich sedimentary lands, and in front of cities, because of the value of land. It is poor comfort to say these floods are trivial to what has happened in Holland, but such is the case. In one flood when the great dykes broke in the thirteenth century, 30,000 people were drowned. In 1717 when a similar break occurred, 11,000 people and 100,000 cattle were lost. The sea-wall, a great dyke 170 miles long, is continually guarded and maintained at all points. The internal system amounts to more than 700 miles of dykes. The work of reclamation is still going on. Forty years ago, 60,000 acres were reclaimed at Lake Haarlem, and now the Zuyder Zee is to be drained, not wholly, but sections of it amounting to 450,000 acres.

The Northern Pacific Railway has from its inception been an odorous enterprise, offensive in the nostrils of honest people. A reliable contemporary says the Chicago terminal property that cost \$8,000,000 was assessed to the stock and bond holders at \$20,000,000, in other words, \$12,000,000 was stolen, and the manipulators have run away for fear of prosecution. This last was unnecessary. \$12,000,000 will “stand alone” before any tribunal available to the wronged people, and the transaction is a kind of business by far too common in Chicago. This goes out to the world, and yet we wonder at disorder and Coxey’s Army. Other corporate property, much of it, is no better, and yet we are astonished at a change in prices and a lack of confidence. The wonder is our commerce is not destroyed and that capital can be procured at all. It is not long since a President of the Nicaragua Canal Co., and some of his coöperators, converted the capital of some mines in Arizona from \$450,000 to \$2,000,000 which was not assuring to those invited to subscribe for canal shares, or any other shares.



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REMARKS ON THE PATENT SYSTEM.*

The problem of personal right, or property in inventions, which is in a sense included in the propositions of the question presented for this evening, has been the subject of profound investigation for more than a century past, with almost constant confirmation by statesmen and jurists of all countries, so that a discussion of the expediency of abolishing the Patent Laws is not likely to do much good, and be a waste of time and effort.

Such laws exist in all civilized countries, Holland excepted, and countries that have abrogated their patent laws have again instituted them, among these Switzerland, where we have reason to believe legislation and a sound national economy has its highest development at this day. Besides, the tendencies of our time do not point in the direction of restricting monopoly, but, on the contrary, to its extension in various forms. This is true of nearly all civilized countries, and especially the United States, where not only the powers of legislation but the construction of laws are warped to promote private interests in a greater degree than at any previous time. Both competition and free commerce are hampered in a hundred ways, and among all privileges permitted or promoted by

*A communication, by Mr. John Richards, read at a topical discussion by the members of the Technical Society of the Pacific Coast, July 6th, 1894. Reprinted by permission.

law, none are so harmless, or have so much to claim in the way of equity, as the questionable monopoly permitted to inventors who obtain patents.

Most patents taken out on mechanical inventions are to prevent imitation and protect manufacturers, and the amount added to the selling price of commodities by reason of such patents is commonly very little and sometimes nothing at all, but there are other privileges granted without the qualifying conditions that attach to patents on inventions that raise the price of commodities in some cases a hundred per cent., and in many cases fifty per cent., such grants or privileges being absolute, and not even binding the beneficiary, at the end of seventeen years turn over to the public a consideration presumably equal to the privilege received.

The natural right of a person to exclusive use of what they may have discovered or invented, or, in legal terms, the property in invention, cannot be questioned upon any other grounds than the abridgement of some right of other persons or the public, and this could only be on two assumptions: one, that the invention or discovery was not new and original, and the other that the public could by other means have acquired the same advantage sooner and on better terms.

A patent is in its nature a contract between an inventor and the public, in which it is stipulated that if the patentee will file in the archives of the Government a complete description of his invention with drawings that will enable others to understand, make and use his invention at the end of seventeen years, he shall for that length of time enjoy a monopoly and exclusive use of his discovery.

This grant is not absolute, but is conditional on the invention being new, and that it does not interfere with rights and privileges already existing. It is also qualified by other conditions, such as the perspicuity of the description and its completeness, also the language employed in defining the scope of the patent, so that, on the whole, letters patent in this country seem in comparison a tame kind of monopoly, and indeed is only a reasonable bargain with the principal stipulations against the patentee, who must maintain at his own expense, and risk all the conditions imposed upon him in the grant.

These remarks upon the nature of patents for inventions are necessary in order to properly consider the practical working and the abuses of our patent system, to which the question of this evening seems to be directed.

The extent of the influence of patents on our industrial interests in this country is not known, or suspected even, nor are the methods of that influence very well understood. There are very few manufactures started at this day that are not founded on some kind of protection. This may be by large aggregations of capital, and an organization that permits cheap production; by combinations of a number of manufacturers to control prices; by secret processes and special skill acquired throughout generations, and by patented rights that secure to the manufacturer the exclusive use of certain implements, processes or products; also by a combination of two or more of these means, often all of them in the case of extensive manufactures. Among these means of founding and protecting manufactures only two are open to a poor man, or a small manufacturer, the secrecy of processes, and patents, as before said, and in these rest the greater share of new ventures in the skilled industry of our country.

It seems a strange proposition to oppose monopoly with monopoly, but in this case it is done. It is almost the only means left to a people struggling against vast aggregations of capital and resources that are dragging us each year nearer to socialism.

If, in this City, one of our large iron works had free use and control of all the inventions in that branch of mechanic art, there would soon be but that one works here, and the owners would paternally care for all the people employed, or connected with that industry. It would be the same thing if extended to other interests, and the division of industry would cease in the various branches now carried on. Opposed to this concentration is our patent system. It stands almost alone, but its power is great, and with intelligent and honest administration of our laws it insures in some degree a division of our manufactures, and permits people without large capital to carry on business. Whether it is desirable to narrow individual enterprise and concentrate our industries in large combinations is another phase of the subject that cannot be discussed here.

The agency of patented inventions in developing and improving processes and products is the argument commonly set forth in support of a patent system. Whatever this influence may be it is of less importance than the one just mentioned. The "nature" of what we call progress at this day is much less important than the "manner" of it and the social effects resulting therefrom, hence this point may also be passed over here.

Reverting now to the modification of our patent laws, there are several serious impediments to reform. There is first the difficulty

of securing the required attention and service in Congress to this or any other matter of National concern. There is no one to promote new measures of the kind. The country at large has no Representatives or Senators in Congress. These all represent the interests of their especial districts, States and constituents, also themselves, and there is no direct incentive to inspire legislative effort on behalf of Federal laws of general and equal application.

The Patent Bureau at this time has not more than one half the office room required, but has a credit of between three and four millions of dollars in the patent fund, a surplus of fees paid in by inventors, and so long as a requirement so obvious cannot engage the attention of Congress there is little hope of amendment of the patent laws. Other kinds of grants and monopoly require all its time and energies.

Within twelve days past a duty of \$2.07 per thousand has been assessed on blasting caps, a little more than the worth and price of the caps. There are two makers of such caps in this country. They have received a patent without promise of turning over their processes and inventions to the public at the end of a term, and have the farther advantage that the Government in effect collects the royalty from the miners and turns it over to these two makers of blasting caps. This is mentioned as the kind of patents that Congress is just now engaged upon.

Another impediment is the want of understanding the nature of letters patent for inventions as a part of the National economy. The subject has engaged the attention of the most eminent men in all countries where patent laws exist, and one has only to look over some legal decisions to see the great complexity of the subject. It is one that must be viewed in the concrete, and is so mixed up with industrial and commercial affairs of the country that not one congressman in fifty could vote intelligently upon a modification of the laws, much less draft and promote new measures.

Mechanics and engineers do not often go to Congress, and happily are not often concerned in what we call politics. The late President of the French Republic is almost the only engineer that has ventured into national administration. Col. Turretini, Mayor of Geneva, is the only other that can be called to mind, and there is little wonder at the difficulty of dealing with patent laws in a popular legislature.

These remarks indicate the temerity with which suggestions should be entered upon here, but the present remarks would be

incomplete without some criticism of the existing law. Our patent system, while it has many excellent features compared with that of other countries, is anomalous in respect to what is called the examination of applications for Letters Patent. There is examination, as the term applies, and to this there can be no objection. On the contrary it is a great aid to the inventor and his attorney, saving searches that would be expensive, and even impossible, with the usual resources at hand, but the functions of the examining officers do not stop with their search. They do not, as an engineer, lawyer or other professional man would do, endorse the facts and their opinion on the application, or enter them upon the record, but are obliged to exercise judicial functions, and decide the case on their own evidence, that is "reject" the application if in their opinion the alleged invention is not new. Such a perfunctory duty must be as disagreeable to the examiners as it is illogical and unjust to an inventor, because it assumes the power of destroying a patent with no corresponding power of confirming it. This is left for the inventor to do after the patent is granted, and no doubt should be, but on what grounds should a primary examiner reject a patent when he has no power to confirm it? It is placing on him perfunctory duties that implies his want of ability to arrive at and record a professional opinion; puts him in the position professionally of a routine clerk, and officially in the position of a judge.

If the examiner's views were endorsed on the record, and the applicant had the right to appeal or call for further opinions of higher officers up to the Commissioner, the procedure would be logical and just. Patents would then be issued with a full record, and at the applicant's risk, as is done in most other countries, where repeated and invalid patents are less often granted than they are here. As it is now, a patent when issued bears no record of the office procedure, but no one thinks of purchasing a patent without sending for a transcript of what is called a "copy of the file," in the case. This should be printed with the patent at its issue, so that anyone concerned in the matter would have the whole record before them.

There are many other reasons against rejections or the judicial functions of examining officers, that are engaging an increasing amount of attention in this country, and will no doubt in the end lead to some change beneficial alike to the Bureau and to inventors.

Time will not permit a notice of some other points that could be profitably presented before the Society at this meeting, and but one other will be named,—respecting trade-marks. The present law on

this subject seems to be founded on the assumption that a trade-mark, registered in the Patent Office, is an attribute of the goods to which it is applied, and not a personal matter relating to the firm or company that applies for registry. The applicant is called upon to define particularly the class of goods and also the articles in that class, to which the trade-mark is to be applied.

As a matter of fact, obvious to any one, a trade-mark is a short way of endorsing the name of a firm or business on goods without using personal names, that may be changed, and in this sense has no particular relation to the articles on which it is marked or stamped. The purpose is to set forth that a particular person or firm produced the goods, and the laws of registry should certainly be based on that fact and not on the assumption that the trade-mark is an attribute of the goods themselves.

Having consumed the allotted time, and perhaps more than was intended, there is but one thing more to add, that is, some mention of the honest and faithful administration of the Patent Bureau. It ranks first, and stands with the Coast Survey Office and Army Engineer Corps, in this respect. Thirty-five years of continuous intercourse in one way and another with the United States Patent Office has not but in two instances brought to knowledge the least charge of misconduct in that Bureau, and in both these cases such charges were confined to the chief officer.

Our patent system may have faults, and naturally falls under suspicion sometimes, by those not acquainted with its organization and history, but such suspicions are groundless, in so far as the long experience before named has disclosed.

It is respectfully submitted that any abrogation of the patent law is not only inexpedient but impossible. That patent grants for invention are equitable and the least harmful among many privileges conferred by Federal laws, and that the abuse of patent privileges is less than in the case of other laws creating privilege and inequality; also that their improvement is both possible and probable when Congress can be forced to give some attention to National affairs.

THE LAW OF TRADE-MARKS.

The law relating to trade-marks in this country is peculiar, or at least the construction of it by the officers of the Patent Office seems so. A trade-mark is construed as if it were a feature or attribute of

the particular goods to which the mark is affixed, and not a personal or distinguishing mark of a person or firm using it.

Logically, a trade-mark has two objects, to attract attention by being unique, and to represent a firm or company in a shorter manner than by printing the whole name, also to avoid changes in the names of those who may own the business, but in any case it is of a personal nature rather than an attribute of the goods to which the mark is affixed.

The law in respect to trade-marks in the first section says that registration of trade-marks can be made :

“First.—By causing to be recorded in the Patent Office a statement specifying name, domicile, location, and citizenship of the party applying, the class of merchandise, and the particular description of goods comprised in such class to which the particular trade-mark has been appropriated ; a description of the trade-mark itself, with facsimiles thereof, and a statement of the mode in which the same is applied and affixed to goods, and the length of time during which the trade-mark has been used.

Second.—By paying into the Treasury of the United States the sum of twenty-five dollars, and complying with such regulations as may be prescribed by the Commissioner of Patents.”

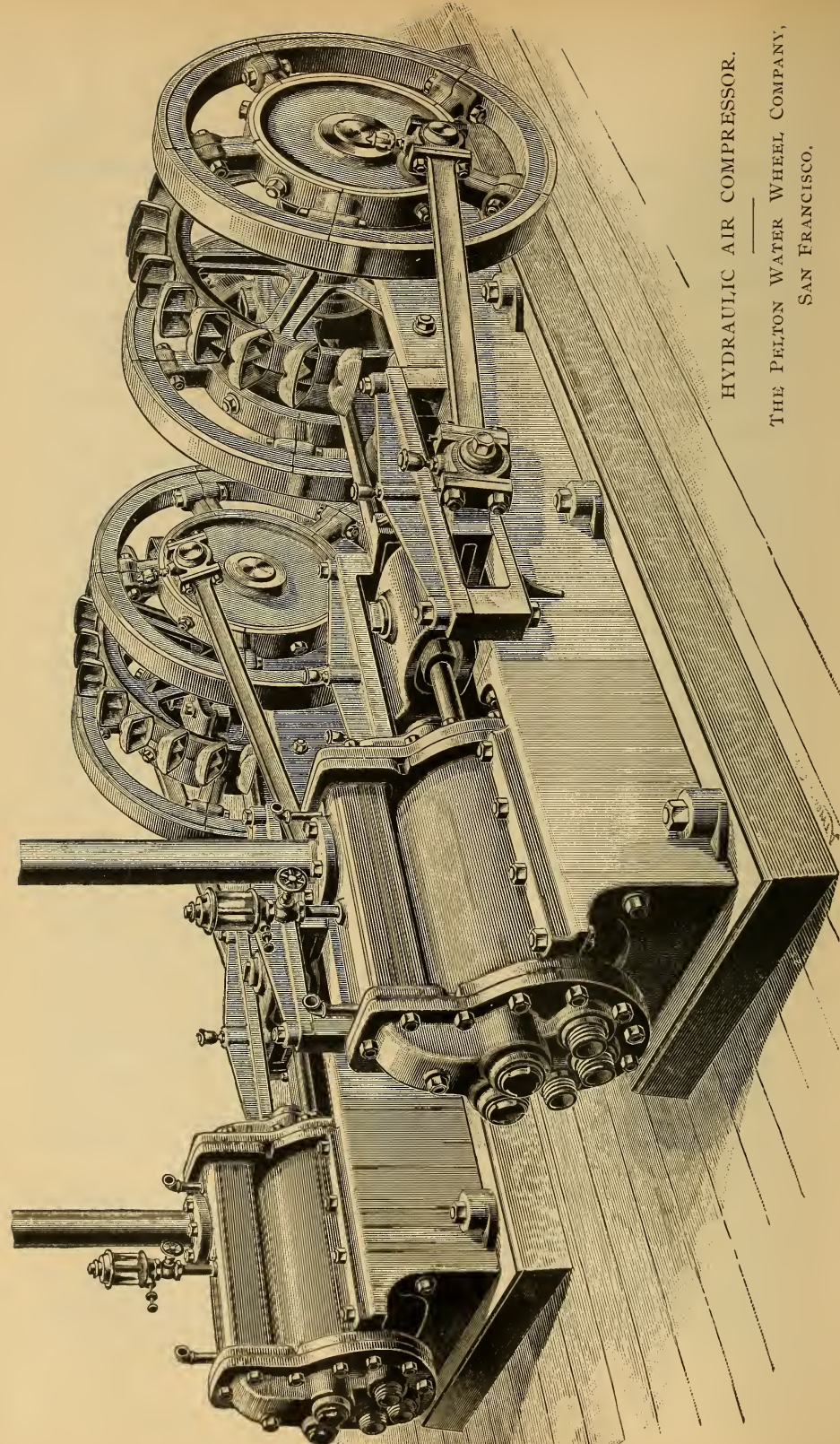
Referring to the first section, and to the words “the class of merchandise and the particular description of goods composed in such class.” The word “class” and “particular description” have caused a great deal of difference of opinion.

The Hon. John S. Seymour, present Commissioner of Patents, has, in a late decision, (*Ex parte Silvers Appeal in Trade-Mark Application April 27, 1894*) presented what seems to be a wholly new construction of the law, and one that will, no doubt, be confirmed by the Federal Courts if adjudication be had in this matter. Commissioner Seymour says :

“The Congress has not attempted in the present law to define classes of merchandise or to establish classes. The Federal legislation upon the subject of trade-marks takes trade as it finds it, having its origin in some State, with trade-mark rights pertaining to it, and if such trade extends in any case to foreign nations, or to the Indian tribes, then the trader may have the benefit of the Federal trade-mark law on complying with its prerequisites. * * *

There is no authority for requiring the subdivision of applications to accord with the Office classification of trades. Registration can be limited by nothing narrower than the actual and lawful use of the mark in the place where the business is located.”

The word “class,” as applied in manufactures, is wide and inclusive. For example, we speak of edge tools, hardware or wood-



HYDRAULIC AIR COMPRESSOR.

THE PELTON WATER WHEEL COMPANY,
SAN FRANCISCO.

work, as classes of manufacture, and particular description of the products in either case would be impossible, still a person or firm in either of these trades should be entitled to a registered trade-mark if they applied therefor. In the case of edge tools one might mention scythes, chisels, plane irons, draw knives and dozens more of various kinds of tools, but would have to at the end wind up with some general statements such as "the like," but who could imagine a trade-mark not applicable to *any* edge tool produced by the owner of a trade-mark, the fact being that the mark relates to and declares the maker, and inferentially the quality of the tools because of the standing of the maker.

Commissioner Seymour points out that the Federal laws and registry of trade-marks relate to foreign commerce and Indian tribes, because the various States have laws governing such marks, and intimates that the patent office has no authority to narrow or improve new and different classifications and description. This also seems logical, if not law, a distinction, however, that is not always to be wondered at.

HYDRAULIC AIR-COMPRESSING MACHINERY.

THE PELTON WATER WHEEL CO., SAN FRANCISCO.

The compressing engines shown in the perspective drawing on the page opposite, is a case where the impinging force of the water is brought almost directly against the compressing pistons. It will be observed that the movement of the compressor pistons at middle stroke is nearly one half that of the water wheels, and in this particular the arrangement is novel.

The engines and wheels were made by the Pelton Company for a mine in Peru, and were divided into sections so as to be transported by "burro" trains into the Andes Mountains. The water wheels are four feet in diameter, driven by a head of fifty feet, and run at a speed of 120 revolutions per minute. This produces a piston speed of 360 feet per minute. The mine where the plant is to be erected is 10,000 feet above sea level, and the attenuation of the atmosphere at this height makes a high speed more desirable.

The exceeding simplicity of the whole structure, as well as the completeness of the drawing renders detail description unnecessary. The company are more and more discarding "intermediate gearing" for all the various purposes to which their wheels are applied, and with a corresponding gain in weight and endurance.

TAXES ON SHIPPING.

The Hon. Eugene Chamberlain, U. S. Commissioner of Navigation, is, in our opinion, doing more to augment the United States merchant marine than all the "clap trap" that has appeared on this subject for twenty years past. What he is doing is in showing up in an unquestionable way the impediments to ship owning and ship-building in this country, and among these are taxation of property in shipping at various ports.

An advance memorandum from the Commissioner shows that in Great Britain, France and Germany there are no taxes on shipping, but on the "earnings" only. In this country each port has its own system of taxation. In Chicago shipping is taxed at insurable value, consequently few vessels are listed there, only \$3,000 worth of tonnage, perhaps one hundredth part that should be. In some ports there are no taxes at all, Wilmington, Delaware, being one. In Boston vessels in foreign trade are exempt. In New York there are no taxes on the stock of companies operating vessels in foreign trade. In Philadelphia vessels are free.

Last year shipping owned at this port was taxed \$75,800 for "municipal purposes." What in the name of common sense have ships to do with municipal affairs? They do not use the streets, lights, sewers or anything else that City taxes provide. They do not even "come to the City," which lies 150 feet or more away from the water front. They were also taxed \$42,400 for "State purposes." This is irony, as well as robbery, because the ships pay in wharf dues for the privilege of landing and discharging their cargoes over wharves built with money contributed by the marine, \$36 a day for dockage if the cargo exceeds 600 tons, and for less in proportion.

Commissioner Chamberlain says the shipping of this port pays more taxes than are collected from the Hamburg, Cunard and North German lines that have 700,000 tons of the most expensive shipping in the world, worth \$58,000,000. No growth of shipping interest, either in building or owning ships, can be expected under the present system. The fact of Americans sailing under a foreign flag, to escape taxes and dues, is enough to show how far we are from establishing a foreign shipping trade.

What would our people think or say if Norwegian ships came in here under the British flag, or Canadian ships under the banner of

Mexico. We are making ourselves ridiculous in the eyes of the world, and are suffering losses that a generation to come will not rectify. Marine taxes, bad as they are, do not make up one half of the special dues and exactions that shipping suffers, in this port especially, where dues of all kinds are excessive and more than in any other port of the world.

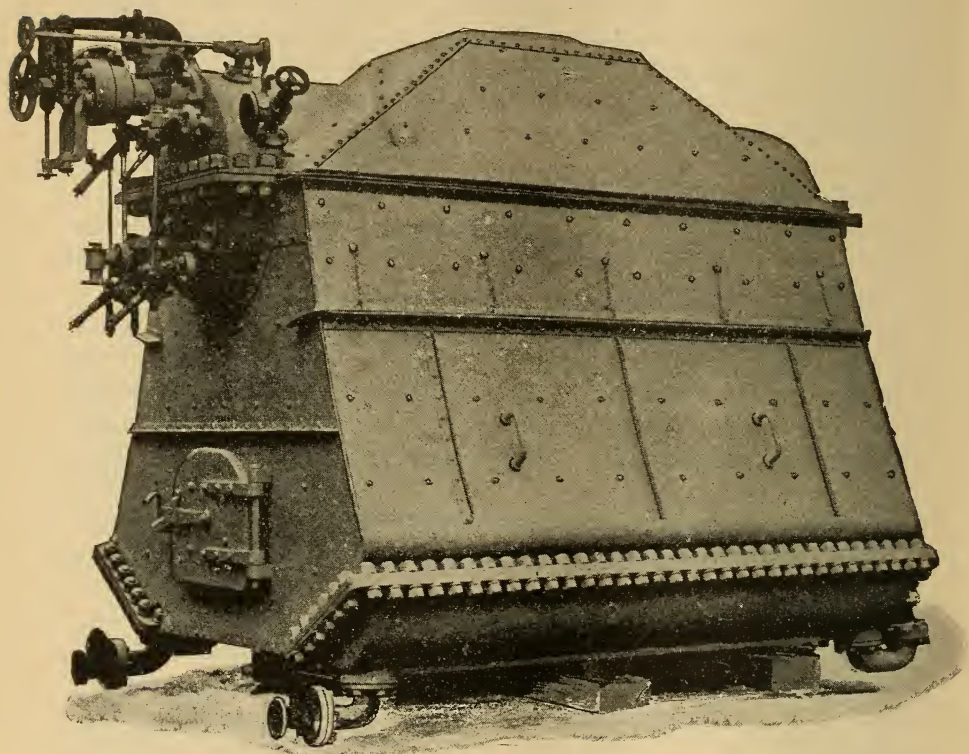
THE WEST END RAILWAY OF CHICAGO.

The change of the West End Urban Railway, of Chicago, from steam to electric locomotives is a significant fact, and will be the first case, as the General Electric Company claims, where such a change has been made. The machinery is now being made at the Schenectady works of the Company, and will consist of four dynamos, two of 2,000 horse power, and two of 1,000 horse power each. The conductor will consist of a third rail alongside the service way. On this rests a sliding shoe supported from each truck of the motors or locomotives.

Thirty-five of these locomotives are being prepared for the service, each to have at the beginning two motors, with provision for adding two more when the traffic demands other power. Their cars will be hauled at a speed of thirteen miles an hour, including stops, with four motors six cars will be hauled at a speed of fifteen miles an hour.

The service will be much cheaper than under the old system, a matter that concerns the shareholders mainly, but also will be more comfortable for passengers, and less annoyance along the line. The road is, of course, an elevated one, thus permits the side-rail conductor before mentioned.

The success of the Intramural line at the Exhibition furnished a good deal of data on which the present scheme is predicated. The president of the West End Line is Mr. R. S. Heyes, also president of the St. Paul and Duluth Railway, and a director in the Metropolitan Traction Company of New York, also is connected with the Atchison, Topeka and Santa Fe system, and presumably understands well the conditions under which the West End Road is to operate.



THE YARROW WATER-TUBE BOILERS.

In our May issue was given a description and sectional drawings of the Yarrow water-tube boilers as furnished for the *Hornet* and various high-speed vessels, but no elevation showing the boilers as they appeared when completed.

We applied to Mr. Horace W. See, of New York, the agent in this country, for an elevation of the boilers when complete, which did not reach us in time for the July number, but is given above. By this it will be seen that the dimensions are not much increased by the furnace covering, which is of metal, lined with refractory material and provided with removable plates at the sides as indicated by the handles. There are in these boilers, we imagine, a good many features that will be found in the ultimate design of water-tube boilers, if we ever attain a design that may be so called.

THE GREAT STRIKE.

"What is to be said in INDUSTRY about the great strike?" was the question just asked by a friend. A good deal has been said in this Journal during six years past that turns out tolerably good prophecy. The railway strike itself is a great fact in so far as the disastrous effect upon the country's industries, and comes at a most unpropitious time, when there is little power to withstand disorder, but the great fact of all is not the strike, but the causes that lie at the bottom of it, and the sympathy of the great mass of the people with the strikers.

These causes began nearly thirty years ago in the cotton speculation at the end of the Civil War, then in the Freedmen's Bureau and the "carpet-bag" regime in the Southern States. The commercial community were corrupted and intoxicated with vast gains wrought out under semblance of law. The methods became chronic, and a part of our economic system. Schemes that were scandalous then have become only common business now.

Can anyone who has come to older age, and remembers the circumstances of our country thirty years ago, imagine such a thing as the Credit Mobilier, the Robeson and Chandler Naval Administration, the Dorsey Star Route Frauds, the Whiskey Ring of 1872, the Jay Gould Maneuvers of 1880, and the constant succession since then of fraud after fraud, concentrating the wealth of the country in the hands of a few, and raising up the ubiquitous tramp, previously unknown in this land? The people, hopeless, worn and tired of these scandals following in the sacred trust of office, have exhausted their patience, and now in desperation look with indifference, if not sympathy, upon a strike which is in its main features illogical and unjust.

"Purification of politics," which Senator Ingalls, of Kansas, two years ago pronounced an "iridescent dream," must come nevertheless, if not by votes, which seem to avail nothing, then by more drastic means, and this very spirit, which now upholds the great strike, is the very foundation on which must be erected a purer state of things. The popular sentiment of this country is honest in sufficient degree to "purify politics," and they will be purified in some way, and that before long. The history of the past will show that wrongs against a commonwealth cannot endure.

A sentiment strong enough to include the operating force of the Southern Pacific Company must be one to command serious atten-

tion. Whatever may be said of the history, management and public policy of this Company it must be conceded that their treatment of employed people is such as to earn unqualified loyalty, still we see all this ignored, and in obedience to a spirit of wrong endured elsewhere, these men imperil dependence for a livelihood, forget the favors received, and paralyze the whole business of the Coast. It is the cause of this that should engage attention now. The stoppage and resumption of railway service is not the principal thing to be dealt with, there must be a change of economic policy and business methods in this country, privilege and favoritism must perish or the Government must perish.

The strike will, no doubt, be ended long before these words are printed. How, it matters but little, so long as loss and destruction do not result, but this is only the turbulent beginning of a protest against a disregard of the only power left to honest men, that of the ballot. That a consensus of popular opinion has been disregarded in the present Congress need not be argued. The ballot has failed, or at least this is a prevalent feeling in the community, and is a chief cause of discontent that sustained the great railway strike. No one cares much for the Marquis Pullman, or his paternal village at Chicago, of which the people on this Coast have little or no knowledge, except that five to eight millions of property is expended by fraud to thirty millions, on which dividends must be earned. It is but one of many such frauds of our time, and in this kind of thing is the leaven acting on the spirit of unrest.

THE MARIN PENINSULA.

The North Pacific Coast Railway, under the management of President Stetson, has, in the last year, become in many ways a new property. Notwithstanding it has been a period of depression, or even discouragement, the company have gone on, and constructed a new pier and a large station at Sausalito that must have cost \$50,000. Various other improvements, such as hydraulic apparatus for operating the stages, electric lights in the station and yard, have been added, and now a new steamer of 1,800 tons burthen, 255 feet long, 83 feet beam, and 68 feet over the guards, has been added to meet the requirements of increasing traffic.

This steamer, the *Sausalito*, was constructed by the Fulton Engineering and Shipbuilding Works, of this City, in the remark-

ably short time of 150 days, that being the time from laying the keel blocks until regular service. This we think has not often been exceeded, the usual time of constructing such a steamer being at least a year, and from that to a year and a half. Among a number of new features in the *Sausalito* may be mentioned surface-condensing engines, and notably among conveniences an extension of the main saloon entirely across the steamer, the sides being of glass so as to not obstruct the view.

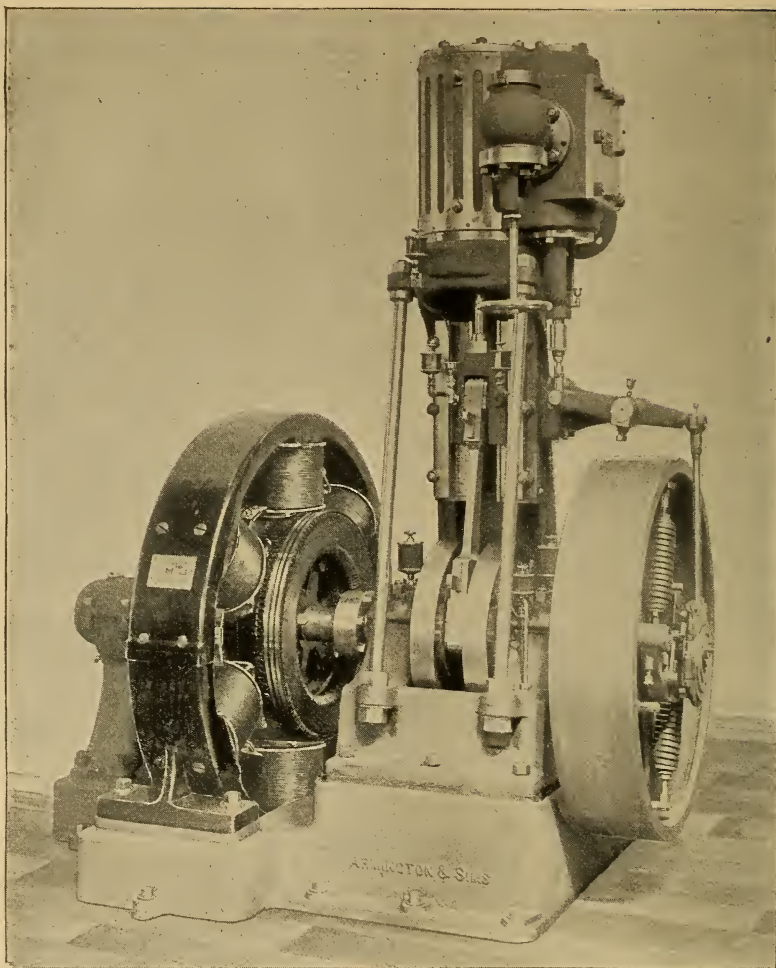
This idea of the President, Mr. Stetson, was to meet a condition of service across the Golden Gate that is peculiar. To escape the trade winds on steamers having open saloon guards the passengers all crowd to the leeward side, and this, with the force of the wind on the other side, causes a dangerous list when the winds are strong and a large number of passengers are carried. On the present new steamer there is no occasion to go to leeward, everything is housed from the wind, but the view is unobstructed, and as the "lookout" is more interesting to windward it balances the "cargo" against the wind and "trims" the vessel. It is a most comfortable and sensible idea.

The company are also in a most commendable way re-arranging their approaches at Sausalito to add to their own yard room, and widen the main street of the town toward the northwest. This street is really the water outlet to the Marin Peninsula, and of Marin County, through which passes nearly all the wheel traffic to tide water.

These improvements will open up to San Francisco a suburb unique in character, picturesque, and with all the ideal conditions of a suburban resort. The mountain, 2,700 feet high, is but a few minutes' run from the pier, and in its deep redwood cañons are places such as visitors to the Coast go hundreds of miles in other directions to see.

Forty-five minutes' run from the City can be seen the remains of redwood trees forty feet in diameter, rivaling even the giants of the Calaveras forest, but the main thing of all on this Marin shore is that it is a windward one, and has a deep water front. For miles the largest vessels can come direct to the shores, and are protected from the western winds by a range of hills 700 feet high.

Unless all signs fail, the North Pacific Coast Company are only preparing for a traffic that in a few years will fully occupy the fine facilities now being provided in a liberal scale and most permanent character.



25-KILOWATT GENERATOR.

THE GENERAL ELECTRIC CO.

The plate above, taken from one of four generators recently furnished by the General Electric Company for the Manhattan Life Insurance Building in New York, is typical of what may be called advanced design for steam dynamos. The engines were made by Messrs. Armington & Sims for the General Electric Company, and the design is a standard or stock one adopted in the works at Schenectady, N. Y. A good many in looking at this, and analogous types of our time, will remember the Oerliken machines at the Paris Exhibition in 1886, which then seemed strange enough, but are now familiar all over the world.

Continued from page 404.

CENTRIFUGAL PUMPS.

[COPYRIGHT, 1894, BY JOHN RICHARDS.]

In deep pits, such as are common in the irrigated districts of California, the pumps have to be set 40 to 50 feet below the surface in order to be within suction distance of the water. Such pumps, from 4 to 6 inches bore, are driven by vertical shafts extending up to the surface where the driving power is applied. The shafts are commonly $2\frac{1}{2}$ inches diameter, and weigh with the couplings and fittings at least 20 pounds per foot, or for 50 feet 1,000 pounds. These shafts with the impeller of the pump, to operate well, must be balanced by water thrust, which in the case of disc impellers is provided in a very ingenious manner, shown in Fig. 7.

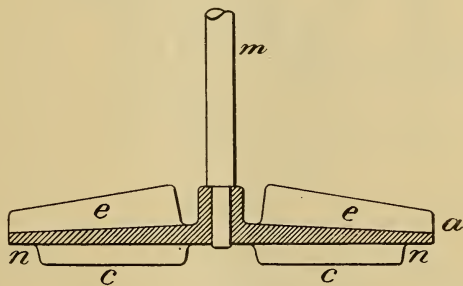


FIG. 7.

The water enters on the top around the shaft *m*. The impeller disc *a* is provided with working vanes *e* on top, and balancing vanes *c* on the bottom, the latter enough shorter than the top ones to produce a modified centrifugal action beneath the plate, and this difference when adjusted is made to sustain the weight of the shaft *m* and all of its connected parts, weighing from 800 to 1,600 pounds. If the up-thrust or balancing is not enough the impeller is taken out, and the ends of the bottom vanes trimmed off at *n* until an equilibrium is obtained. The bottom vanes *c* are commonly one third shorter than the top ones *e* when the discs are 24 to 30 inches diameter, and it is surprising to see what an effect is produced by cutting off even half an inch from the ends of the vanes at *n*. This method of balancing disc impellers for centrifugal pumps is also applied to

NOTE.—Since the publication of the first chapter in this series of articles, Professor F. G. Hesse, of the University of California, has signified his intention of contributing some facts of much interest, and correcting an error made in respect to his connection with, and invention of the "hydraulic step," showing that the problem of balancing centrifugal force was resolved by him in all of its elements and phases, also applied in practical construction, in 1865. This matter will appear in the body of these articles during their progress, or in an appendix at the end.

encased impellers, as in the case of pumps illustrated in Fig. 5, and is shown in its most complete form applied to a horizontal pump in Fig. 2, which is repeated here for convenience of reference.

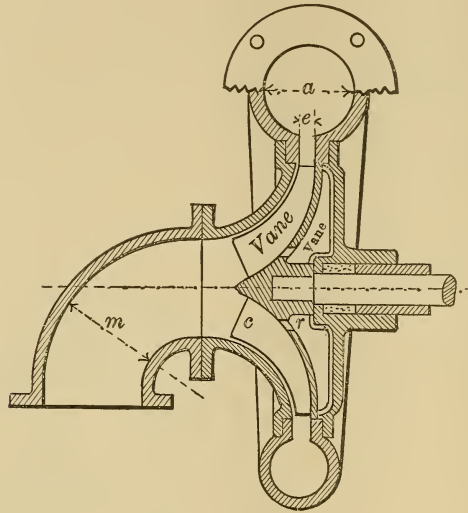


FIG. 2.

It will be noticed there are vanes on both sides of the disc, those on the back being to set up there the same centrifugal action and force that exists on the front or working side. It will also be noticed that the back or balancing vanes are a little shorter than the front ones, commonly from $\frac{3}{8}$ inch to $\frac{3}{4}$ inch for pumps to 10 inches bore. This slight difference in the length of the vanes, or the diameter over their tips, permits a slight excess of pressure on the front or working side, and consequently a slow flow of water over the periphery of the disc into the chamber behind; some small holes r being provided for circulation. If the rear or balancing vanes were as long as the main ones, and centrifugal action the same on each side, the rear chamber would become partially or wholly filled with air, and the equilibrium destroyed.

This method of balancing the lateral thrust on disc impellers was first applied by the writer in 1886, and is believed to be more reliable than double inlets. It may be described as providing for equal centrifugal action on each side of the plate or disc, but performing the whole work of propulsion on one side.

Attention is called to the curves and course of the water through the pump shown in Fig. 2. Such easy curves are not attainable in double-inlet pumps, but very nearly so in another method of balancing plate or disc impellers next to be explained.

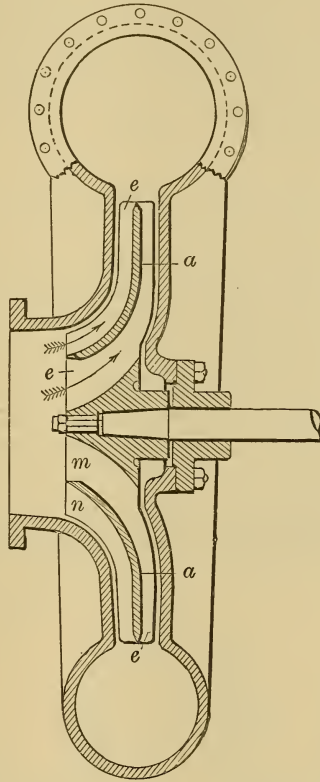


FIG. 8.

This method, shown in Fig. 8, is one of recent invention, and apparently the most complete that has been discovered. It consists, as can be seen, in receiving the water at one side of the pump, thereby attaining the several advantages of that method already pointed out, and has the same balancing effect that is attained by a double inlet, but avoids the short curves and consequent obstruction, that seems inseparable from the double-inlet method; also avoids placing the shaft or spindle through the inlet pipe or pipes. The water passes in equal volume on each side of a disc or web *a*,

the outer and inner annulus m and n being equal in area. The curves are easy and the construction strong, because the disc or web a acts as a continuous brace between the vanes e .

The distinction from the method of balancing last described is not only in the manner of operating, but also in the construction of the impeller itself. In the present case the vanes rise out of the boss or hub the same as with an open impeller, the disc a forming only a web or brace for the vanes. In Fig. 2 the disc itself is the main member, the vanes being set thereon in the form of ribs.

BALANCING ENCASED IMPELLERS.

When the impellers of centrifugal pumps are encased, as shown in Fig. 5, the compensation of lateral thrust is an easier problem in one respect, and a much more difficult one in another respect. The unbalanced area is only that of the inlet a less the area of the driving shaft's section, and the up-thrust in this case is as these areas taken with the discharge pressure, but there is the difficulty in all forms of encased impellers of maintaining running joints that permit waste by circulation.

Supposing the pump shown in Fig. 5, which is repeated here for convenience of reference, to be constructed to operate against a head

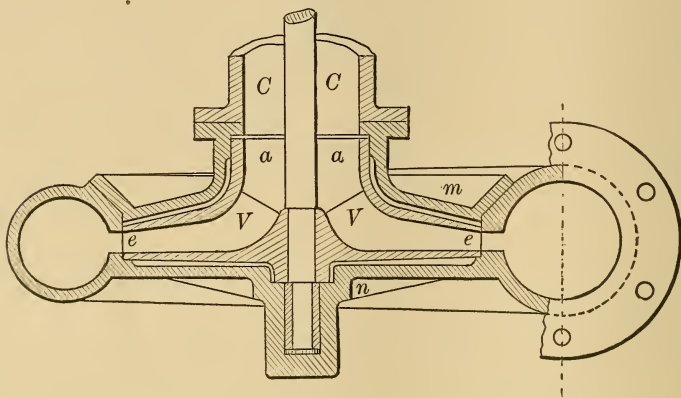


FIG. 5.

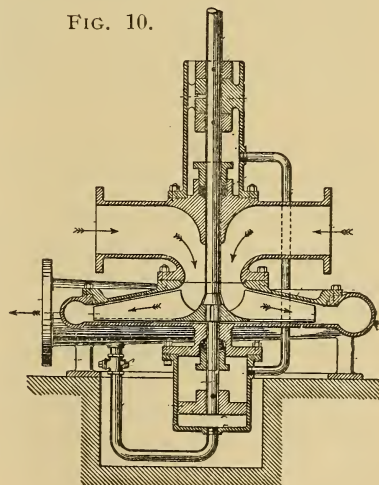
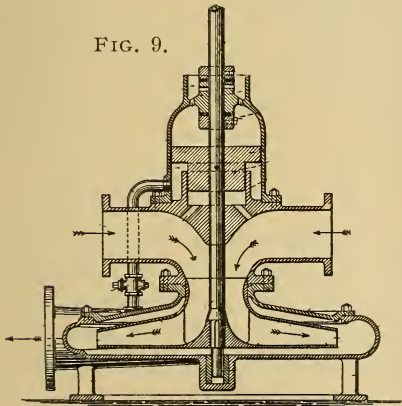
of 75 feet ; to be of 6 inches bore, and have an impeller 30 inches in diameter, and the weight of the shaft and other parts to be balanced 1,500 pounds. These proportions follow average practice for pit

pumps in California, and the type as drawn is from designs by the writer made in 1886. The discharge pressure, counting 5 feet of head for flow or friction, will be 34.4 pounds per inch. Dividing the gravity load by this pressure gives about 35 inches of unbalanced area required to sustain the vertical load. This calls for an inlet area 11.2 inches diameter, which, taken over the outside of the impeller nozzle at *a*, gives a bore of $9\frac{1}{2}$ inches, an average inlet for a six-inch pump of this kind.

It is a circumstance worthy of note that with pit pumps of the kind here illustrated the thrust due to an inlet nozzle of the proper size will balance a shaft of the required dimensions to transmit the power, the increment of weight for the shaft and increment of pressure due to head, following in the same proportion.

In the case of horizontal pumps with encased impellers, and an inlet at one side only, the thrust cannot be compensated by weight as in vertical pumps, and is attained in several ways ; for example : by leaving the center around the shaft open, by a balancing plate opposite to the inlet, or by revolving hydraulic pistons on the pump shaft subjected to pressure from the discharge water.

Since the above was written there has been received from Mr. G. W. Price, of San Francisco, some particulars of a method of balancing impellers by means of pistons, as above mentioned, that has the advantage of ready adjustment for varying heads and speed and is applicable to pumps of any kind.



The drawings in Figures 9 and 10 are taken from the patent specification of Mr. Price, Fig. 9 showing a balancing or thrust piston placed above the pump, and in Fig. 10 placed beneath the pump, the force of the pistons being upward in both cases, and receiving pressure from the discharge-way by means of connecting pipes as shown. As there is unavoidably a leak of water around these pistons, it follows that the pressure on them can be regulated by adjustable cocks in the supply pipes.

In Fig. 9 the piston is compound, receiving pressure from the discharge way on an annulus, and a counter-force for adjustment from the suction acting on the central piston. As, however, pistons thus mounted on the pump spindle and fitting in fixed cylinders, are subject to wear, Mr. Price has adopted a "floating" cylinder for the

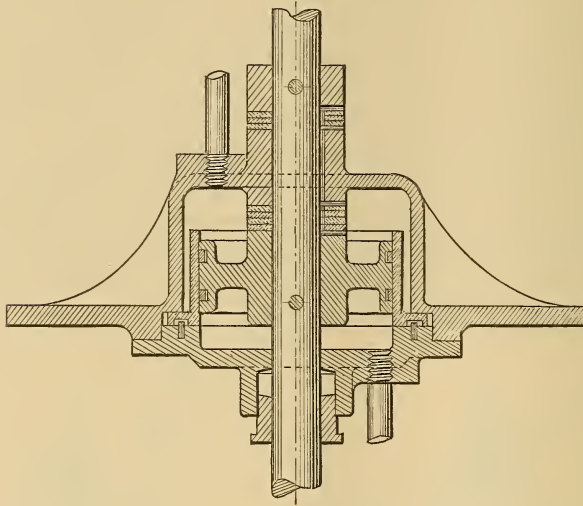


FIG. 11.

balancing piston, as shown in Fig. 11, which is a vertical section through the main bearing and balancing piston as now applied to a number of pumps by the San Francisco Tool Company. In this case it will be seen that the balancing piston fits into a short cylinder capable of lateral movement in case the pump spindle and piston do not run true. The pipe below connects to the pump discharge, and the one above carries off waste water that passes the piston and does not find its way out through the spindle bearing, which is in this manner flooded with water.

In pumps having encased impellers there must always be, as before remarked, a good deal of loss by reason of water escaping or circulating around inlet nozzles. Whatever escapes over the periphery of the impeller flows back to the inlet and is forced through there with the whole pressure due to the discharge head.

The safest way is to place shallow vanes on the exterior sides of the impellers, and set up centrifugal action against the side plates of the pump. This will prevent back flow and circulation without any loss whatever if the side plates are true on the inside. An encased impeller of any form must either set the water in revolution at its sides, or else have running joints to maintain against back flow and circulation. This the writer knows is not a commonly accepted fact, or understood by makers of centrifugal pumps, but accounts, no doubt, for the very uniform practice in Europe of employing open or disc impellers. Balancing by double inlets will be noticed in a future place.

THE FORM OF VANES.

There has been frequent complaint of the failure to derive useful facts, or suggestion even, from the literature such as exists on the subject of centrifugal pumps. Such complaint must continue. In a work on pumps, now lying at hand, there is a table to show the increased efficiency attained by Appold with curved vanes. "These experiments of Appold," the author remarks, "showed that the efficiency of a pump mainly depends on the form of the blades of the fan." A table shows that radial flat vanes gave an efficiency of 24 per cent., angular flat vanes 43 per cent., and curved vanes 65 per cent., the head being 18 feet.

It is hard to conceive what the circumstances were under which such results were obtained, unless it was within what may be called the flow limit. For example, a certain number of revolutions will raise the water to a given head, and ten to fifteen per cent. of added speed will cause a normal flow. The form of the vanes may have a good deal to do with this in so far as modifying speed owing to the friction of the vane tips and some other causes. The results stated must have been caused by not adapting the speed of the vanes to their form, otherwise there is no alternative but to call them nonsense.

This Appold experiment, and some others of the kind as well, give wrong inferences to those not able to understand the nature of forces at work, and have led to a wide-spread opinion that the form of the vanes is a very important matter, whereas experience, as well as rational inference and analysis, must show that aside from the dragging friction of the vane tips their form is in common designs a matter of no consequence, or of little consequence.

In a pump operating under heads from 10 to 50 feet, where the tangential energy is a considerable factor in the effect, the vanes should conform as nearly as possible to the flow of water from the center to the periphery of the impeller, but divergence from this is, as before said, of little consequence.

The function of the vanes is to set the water in revolution, and at heads exceeding 40 feet, is but little more; the most important matter being the drag or friction of their tips on the discharge water in the pump chamber beyond the vanes. To make this understood it will be necessary to again refer to the velocities of the impeller and discharge water around it. The discharge flow is constant, and arranged at from 5 to 10 feet per second, commonly about 8 feet. At a head of 50 feet the velocity of the impeller will be about 50 feet per second, or compared to the discharge flow, more than six times as great, so the tips of the vanes in every 50 feet of movement must drag 40 feet over the discharge water. This friction is a frequent source of loss in centrifugal pumps, and in one experiment tried by the writer showed that twenty-five per cent. of the power applied was consumed by retardation thus caused.

This is a reason for reducing the dimension e in Fig. 2 to its lowest limits, narrowing the tips of the vanes and reducing the friction accordingly, but the point to be presented here is that as the head and velocity of the impeller increases, the vanes should be narrower at their tips and terminate more tangentially. The tips are in fact all that need be considered. These should change from a curve forward for low heads, as shown in Fig. 3, to a true tangent, or as nearly that as possible for heads of 40 feet or more.

To show the absurdity of imputing efficiency to a form of impeller vanes, one need go no further than the practice of Messrs. J. & H. Gwynne, of London, and of Mr. Charles Brown, of Sulzer Bros., Winterthur, Switzerland. Drawings of the vanes designed by Mr. Brown, shown in Fig. 12, are taken from a communication by him to *Engineering*, London, about eight years ago, and which we reproduce as follows:

To the Editor of "Engineering"

Sir :—The explanation given by your correspondent in No. 1,602 of the reason why the circumferential velocity of centrifugal pumps does not need to attain the value $\sqrt{2gh}$ may be one reason, but not the only one. About 1856 I carried out a series of experiments to determine the best forms and proportions of centrifugal pumps, and found that the form of the blades had a very great influence on the circumferential speed required. The annexed sketch, Fig. 12, shows

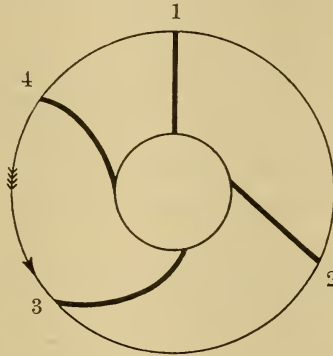


FIG. 12.

the forms of vanes experimented on; the total lift was in all cases 45 feet, the inner and the outer diameters of the discs as 1 and 3. To hold the water at this height, but without any discharge :

- No. 1 required just $\sqrt{2gh}$.
- No. 2 " considerably more.
- No. 3 " still more.
- No. 4 " $0.82 \times \sqrt{2gh}$.

No. 4 form was the best in every respect, and I continued to use it from the time the experiments were made to the present day.

C. BROWN.

The first clause of this communication furnishes the secret of the Appold tables before referred to, and the whole indicates the value that can be placed on the form of vanes. One would be at a loss to refer to any higher authority than the able engineer above quoted, and to suppose that Messrs. Sulzer Bros., one of the most eminent firms in the world, would construct centrifugal pumps of low efficiency is not supposable at all.

The writer in his own practice has not made experiments to determine the efficiency and speed resulting from vanes of different forms, and has never considered it necessary to do so. It is one thing in centrifugal pump construction that seems to be within easy

and rational analysis. The main thing, and that which has led to the many absurd statements, is the change required in circumferential velocity by the form of the vanes and the effect of dragging action on the discharge water by vanes not terminating in a proper shape where pumps are to operate against high heads.

CUT-OFF OR BAFFLING VANES.

By this term is meant the web or vane shown at *s* in Fig. 1. These have also been set up as an important element governing the efficiency of centrifugal pumps, in fact almost everything has been so considered except the point on the outside, and the wonder is that this has not been included among the factors relating to pump performance.

The value of these cut-off plates, which in the Parson's experiments showed an effect equal to one third of the duty, is sufficiently indicated by the fact that one of the principal makers on this Coast, who has constructed a great many successful pumps of all sizes, discards this cut-off vane altogether. Like the form of vanes it is one thing that admits of rational treatment, in so far that such cut-off plates can do no harm. Tangential energy, which these plates or throats are supposed to intercept and direct, does not take place at the point of discharge any more than at other points around the impeller, and the main function is to propel the "slip" between the impeller and discharge water to take place in a line close around the periphery, instead of in a volute path.

As has been frequently pointed out, the circumferential velocity of an impeller is much greater than that of the discharge water around the impeller. At a head of 25 feet this difference is as one to five, or thereabout, and the "slipping" velocity is four fifths that of the impeller. The cut-off vanes determine the situation radially of this line of slip, and whether it takes place at the tip of the blades in one circle, or whether it takes place in what may be called volute strata, between the impeller and discharge water, can only be a matter of immaterial difference. It is best to employ such vanes, for the following reasons: It meets common opinion as to the best form of construction. It can do no harm, and makes a strong tie or connection between the side plates at that point. The following circumstance is the nearest to decisive experiment that can be referred to.

The writer in 1885 designed for a San Francisco firm a dredging pump to be employed in lifting silt from the Bay and sending it ashore in long pipes. The pump casing was of rectangular section around the impeller, volute in form and terminated at the discharge with a throat or passage of six inches clear of the vanes. The engineer of the firm insisted on having a cut-off plate, which was made of steel half an inch thick, and set in at a proper angle, and to clear the vanes by half an inch. The pump was arranged with an open gauge pipe 16 feet high, by means of which the discharge friction head could be observed with precision. The man in charge of the machinery was informed that the throat piece or cut-off would probably "go out" as soon as a boulder or some scrap iron went through the pump, and in that case he was to observe the speed, friction head, and any change in the operation of the pump.

The dredging operations were being carried on in a place where a great deal of iron scrap had been unloaded from vessels, and it was but a short time when the cut-off throat was carried away, and sent out in the shore pipes. The man in charge, a good mechanic, and now a member of a well-known firm of hydraulic engineers in San Francisco, reported that no change could be detected in any way when the throat piece was knocked out, and he preferred having no obstruction of the kind in the pump again.

DOUBLE INLET PUMPS.

In treating upon the subject of balancing the impellers of centrifugal pumps, double inlets were not included among the means by which this could be accomplished, because this plan of construction involves a good deal besides balancing. There are a great many among both makers and users of such pumps who think there is no other way to operate an impeller in equilibrium except to make it symmetrical on each side of a pump, and provide a forked suction pipe with an inlet at each side. This opinion, which is after all not to be wondered at when the complexity of this balancing matter is considered, has been the cause, no doubt, of pumps being made with double inlets, against all the objections, mechanical and other, that applies to this system.

The objections to double or forked inlets are : (1) The impossibility of securing easy entering curves. (2) Inconvenience of access and expense of fitting. (3) The spindles passing through

and obstructing the inlet pipes. (4) Inaccessibility of the suction pipe by reason of its being under the pump. (5) Reducing the inlet areas by dividing them into two parts with a sharp ledge to catch obstructions. (6) Preventing the discharge case from being set at various angles independent of the suction pipes. To these objections can be added general complication and expense not required. In land drainage operations on the Pacific Coast, and presumably everywhere, double-inlet pumps are liable to obstruction by tule roots, bean straw, weeds and other kinds of debris that is unavoidably carried into the sumps.

In the case of double-inlet pumps where the suction pipes are separate, and constitute framing on which the pump chamber is supported, there is a considerable saving of material and several of the objections before named do not apply. There is the advantage for low heads of making the impeller much smaller in diameter, and this permits smaller dimensions in all parts, the general dimensions of centrifugal pumps being approximately as the square of the diameter of the fans or impellers.

As to balancing by a double inlet, this applies only to horizontal pumps, and, as has been explained, can be attained in other ways than by double inlets, at less expense, with easier curves and a more symmetrical construction.

CENTRIFUGAL DREDGING PUMPS.

One of the most successful applications of centrifugal pumps has been for dredging purposes, raising and impelling silt, sand and gravel from the bottom of rivers and harbors. This work has, to a great extent, been done with what may be called water pumps, such as have been heretofore described, but for successful working a very different type is required.

The casing should be rectangular so as to avoid to a considerable extent the friction of tenacious material, and to distribute the impingement from the impeller over a larger area, also to permit a detachable lining that is easily replaced. As an angular section for the pump chamber calls for an impeller of parallel width, there is of course, some loss of efficiency, because of the change of velocity from the inlet to the discharge chamber, but in dredging, efficiency is not the first thing to be considered in designing centrifugal pumps. The main thing is endurance against accident and wear. The pump

itself is but one element among a number that make up a dredging plant, and the main point is to keep all in constant operation.

In pumping silicious material that is heavy, especially fine sand, if a pump stops while the discharge pipes are filled with spoil, it settles on the bottom and packs so as to be difficult to dislodge. The main thing is to "keep going," and whatever tends to security in this direction is more important than a high efficiency of a pump. An open-vane impeller is preferable, because it affords no chance for the lodgment of stones, or other obstructions drawn in, also because the vanes can be made elastic, which is a very important matter, as it avoids danger of fracture when solids pass through.

The discharge-way should be at the bottom, so that solids will not have to be "thrown over" but may pass out as soon as clear from the vanes, also to avoid churning, which is an annoyance and causes delay. Steel or wrought iron is the most suitable material for dredging impellers. The writer has, in two cases, one for a pump of 200 horse power and one for a pump of 400 horse power, used successfully five-vaned impellers of cast steel, but these are open to the objection of requiring complete renewal if worn or fractured, and it is proposed in future cases to employ plates of steel riveted to a square extension of the shaft, as shown in Fig. 3, but with heavier proportions.

In river dredging, such as is carried on in the Clutha River, in New Zealand, the Murray River in Australia, and in the rivers of California, dredging pumps should be arranged with large catch chambers in the suction pipes, otherwise the pumps have to be arranged to pass without injury stones as large as will go through the pipes. This is possible, but produces a good deal of distortion in the design. In no case is there such ill adaptation of centrifugal pumps as for dredging, which is not to be wondered at perhaps, when practice is so diversified for common purposes.

EFFICIENCY OF CENTRIFUGAL PUMPS.

Under this head is to be noted the singular fact that the commercial efficiency of centrifugal pumps is continually considered in their sale, and stipulated for in contracts, while no such guarantee is expected or even inquired about in the case of piston pumps of the trade types. The reason of this is, no doubt, mainly accidental, growing out of the new pumps being a kind of mysterious

machine that can be driven within twenty per cent. of the working speed and produce no result.

Positive pumps of all kinds, or indeed all but centrifugal pumps, discharge water in proportion to their rate of motion, hence there is a distrust of efficiency in centrifugal pumps, not to be wondered at, when such a pump may be driven at nine tenths of its normal speed and discharge no water at all. In most of the experiments that have been published, the main element of all, the speed of impellers, has not been varied and the results included. There is, in fact, no way of predetermining the speed of a centrifugal pump, except by the velocity of the discharged water, and changes of this velocity may greatly vary the working efficiency, or, as said, stop the work altogether.

The most careful and extended experiments for efficiency known to the writer have been those at Ferrari, Italy, where six large pumps of 42 inches bore have been tested for efficiency a number of times over a period of years, showing a result of about 65 per cent. of the engine power in water raised. Equal or better results have been attained with some of the recent plants for draining purposes erected here in California, and it is safe to assume that for large pumps and heads, not exceeding 20 feet, an efficiency of 70 per cent. should be realized from this time forward. For greater heads, and smaller pumps, the efficiency falls off for several reasons. The frictional surfaces of the pipes and waterways increase as their size is diminished, and the friction of impellers as the square of their diameter. One authority, before quoted, claims that the sum of resistances in centrifugal pumps increases as the cube of the velocity. What this may mean is not easy to discern. If velocity of the water is meant, an increase from 6 feet to 8 feet per second would call for 2.37 times as much power to raise a given amount of water, or an increase from 5 feet to 10 feet per second, which is within the working range of such pumps, would demand an increase of power as 8 to 1.

If, on the contrary, the velocity of the impeller is meant, this is as the square root of the head, and its cube root has no application supposable. For example, for heads of 9 and 36 feet, the square roots will be 3 and 6, or, converted to impeller velocity, 24 and 48 feet per second respectively. The cubes of these quantities are 13,824 and 110,592, or 8 to 1.

The true factor of resistance is the head, or its resultant the velocity of the impeller, and a safe rule is to assume a possible efficiency of 65 per cent. for pumps of 12 inches and more in bore,

and for heads of 20 feet or less. For small pumps and heads from 20 to 100 feet, deduct one per cent. from efficiency for each $2\frac{1}{2}$ feet of added head. This may not be scientific or mathematical, but it is very nearly true, which is the important point to be learned, and makers of centrifugal pumps will find it to accord with fair experiments. As the question may be asked, and properly too, how such a rule was arrived at. The answer is, by providing steam power to raise water for irrigating purposes in California, and for heads from 40 to 127 feet. There are at least one hundred plants of the kind in the Santa Clara Valley, where observations can be made to determine the consumption of power in proportion to the head or resistance. In this increase of frictional resistance lies the limitation of centrifugal pumping in respect to the head. In piston pumps frictional resistance increases but little with added head and pressure, being only that of flow and of machine bearings. But in centrifugal pumps friction at the sides and periphery of impellers increases in some proportion, as indicated. It is a matter not very well understood, and, so far as known, the only data to be referred to are the experiments of Professor F. G. Hesse, of the University of California, which will be referred to in his contribution before noted.

A head of 127 feet is above mentioned. This is the highest that has been attempted, and is for raising water from wells at the city water works, San Jose, California. The limitation in this direction is not known, the present lifts being from water-bearing strata tolerably uniform in depth, and from which the water rises to within the distances named of the required discharge level.

II. HISTORY OF CENTRIFUGAL PUMPS.

I presume each prominent nation in Europe considers the invention of centrifugal pumps as belonging to their people, and it was a matter of no concern until the method came to be applied to useful purposes, and took its place as a manufacture, but there is scarcely a doubt that the first organized centrifugal pump was invented by Denis Papin about 200 years ago, in Hesse, Germany, where it was called the "Hessian suck." This pump of the celebrated Frenchman, of which there are drawings in existence, was by no means a bad one,

and in all essential features, except a volute casing, corresponded to the construction afterwards adopted in this country in 1818.

The celebrated Dutch engineer Huet says that Perreboom introduced the horizontal centrifugal pumps in Holland in the first years of the Nineteenth Century, but as no precise date or examples are named, some allowance can be made for Huet's evident prejudice against centrifugal pumping, because he instantly follows this remark with the statement that thirty years later Lipkens made his celebrated single-acting pump for draining Haarlem Lake. Huet's work, *Stoombemaling Van Polders and en Boczems*, 1885, gives scant mention of centrifugal pumping, although at that time such pumps might be said to have supplanted to a great extent the old cumbrous Dutch pumps in Holland, as elsewhere.

Another of the oldest drawings, extant at this time, is that of Le Demours, a Frenchman, dating from 1732. It is a kind of "Barker mill" machine, and the forerunner of various other pumps on the same principle, that of Barker's mill inverted, which have been periodically invented ever since, one within the writer's knowledge a few years ago here in California. The same invention, or "mode of operating," is said to have been discovered in connection with reaction water wheels by their overrunning and drawing the water from the chute or inlet after the gates were shut.

Mr. Whitelaw, an inventor of reaction water wheels in their common or applied form, himself converted the method to pumping by centrifugal force, and made pumps of the submerged type that gave some very good results, which were fortunately tabulated in a careful manner, in 1849, at Johnstone, near Glasgow. These tables contained factors for friction of both water and machinery, with exact measure of resistance and power, that would do credit to a scientific commission of our day. The tables will be given in another place. Whitelaw's pumps were first made about the year 1848.

To begin at the true beginning, when centrifugal pumps first took practical and useful form, we have to, as before claimed, come to the United States.

(To be continued.)

EXTRACTS FROM A NOTE-BOOK.

BY "TECHNO"

No. XXIV.

LA SALLE'S TRIP.—NAPOLEON ANNIHILATED.—ST. ANTHONY'S FALLS.
CATCHING PICKEREL.—A FISHY STORY.—ACCLIMATING FRUIT.
OTHER THINGS.

—————Hereabout, in 1681, La Salle crossed with his expedition to find out where the Mississippi River went to. Crossed but did not take to land as we believe, because it was a water expedition headed for the Illinois River, going to land as we suppose somewhere near where Chicago or Milwaukee now stands. Twenty-three Frenchmen and eighteen Indians with canoes, guns, pemmican and various tackle of the frontier kind.

It was in the winter, and on reaching the Illinois River, they "walked" on the ice down to Peoria or thereabout and then paddled on and on until they came to Chickasaw Bluffs, and made in Mississippi a camp, or "fort" then called, and named it "Prudhomme" then again on and on, paddling with a current running 100 miles in twenty-four hours, the weather getting warmer and spring coming in February, until they came safely to the mouth of the Arkansas River, where Napoleon, a considerable city, once stood. Here the Frenchmen went ashore and acquired a whole Dominion by setting up a pole with the arms of France on it, the greatest "steal" that the world has seen since the time of Alexander the Great.

Napoleon is gone now. The Mississippi made a swerve around that way and disintegrated the town, pulverized the substructure, inverting the superstructures and moved the whole down to the gulf, perhaps in the eternal fitness of things to blot out the theft by the Frenchmen. The circumstance of the conquest is thus described in flowery words by Parkman the historian :

"On that day, the realm of France received on parchment a stupendous accession. The fertile plains of Texas ; the vast basin of the Mississippi from its frozen northern springs, to the sultry bowers of the gulf ; from woody ridges of the Alleghanies to the bare peaks of the Rocky Mountains—a region of savannas and forests, sun-cracked deserts, and grassy prairies, watered by a thousand rivers, ranged by a thousand warlike tribes, passed beneath the sceptre of the Sultan of Versailles, and all by virtue of a feeble human voice inaudible at half a mile."

Who after that can say there is no poetry in history, and that Buckle does not deserve eternal infamy for reducing history to a science.

-----We took boat at Buffalo and here for the first time I inquired about my Uncle's plans. He paid the bills, and I as a guest had no further privilege as to course and object than to inquire.

"We are going to New Orleans," said he, "if money, patience and health hold out. I came around this way to show you two systems of inland navigation as different as chalk is from cheese. One written about, photographed, engraved until every woman and child in the land understands it—a system rising by evolution all the time onward. I mean lake commerce, or boats rather. The other like Shakespeare's 'Seven Ages,' with a youth, boyhood, manhood, decline and fall. I mean the river boats and commerce on them. The first, you can see and read about, and that note-book you may as well hang up for the present. No one will care for any opinions of yours on lake matters. They don't require your views or mine, besides you will need all your paper and energies further on.

"This steamer is typical of the whole lot, perfect in all appointments, including an opinion of every one on board, that it is the finest service in the world, and it may be, at least ought to be. A grievous cupidity and shameless utilitarianism has discovered that a hideous form of steam barges can earn more money in carrying dead loads than a regular steam-ship can, and now seek to debase the whole tribe with flat bottoms, porcine snouts, and covered-in decks, a kind of portable warehouse, called "whalebacks." If you see one don't mention it, let us pursue our journey in comfort."

I notice in these Lake steamers the commendable feature of longer connecting rods, more accessibility all over, and what is certainly advanced practice in marine engine building. Here and there the sections seem fearfully scant, especially in the castings, but the factor of safety is no doubt as usual based on the distance between ports.

We went on up to Cleveland, Toledo, and into the Detroit River, a most wonderful stream having most of the features of a river, and lacking some. It is like the Niagara, St. Clair and St. Marie Rivers, a connection between lakes, always clear, at one level and flowing in peace.

From Detroit, which seems to be the best paved, sewered, lighted and managed city in America, we went through the river and Lakes St. Clair, Huron and the Sault Ste Marie Canal into Great Superior to Duluth, and thence to St. Paul by rail.

My Uncle had intended to go on to St. Joseph, but changed his mind. "The sewer of sewers," said he, "the Missouri River has only one really useful function, that of creating sedimentary land. It is a builder, leveler, fertilizer and irrigator of endless cornfields, and generator of miasmatic effluvia, but it has made an empire withal. It is all over the country, first one place and then another, bristling with snags, spotted with sand-bars and a terror to steam-boats. When I was younger and knew less, I handled the puppet levers up there. It is not a pleasant recollection and we will take to water here and go down stream."

St. Paul, St. Anthony, and Minneapolis are really one place, and hereabout is the most romantic place I have seen on the Mississippi River except at Lake Pepin. St. Anthony long ago, twenty years ago or more, was consolidated with Minneapolis, which was a great mistake, in so far as names. St. Anthony was on the eastern side of the river, had a beautiful name, while "Minneapolis," a combination of Indian and Greek is perhaps the most ridiculous name on the continent—a childish and provincial conceit.

Here the Mississippi tumbles over a cliff 82 feet in all, and affords a wonderful water power. There is a deep stratum of yellowish-white sand-stone of thickness not apparent, and over this a capping of hard rock like the crust of a pie. As the water wore away the sand-stone beneath the falls, the shelving top rock would break off and fall into the pool below. This process went on continually but not very fast, until at great expense artificial work was made by the Federal Government and the State to stop the falls from receding.

The white soft sand-stone is quite a factor in the development of the water power plants here. To arrange one, a tunnel for a tail race or discharge way is dug under the cap rock out to the desired site for a wheel pit; another canal is made, on top, to conduct the water from above the falls, and then a well hole is cut through the cap rock to connect the tunnel and canal. This forms the wheel pit. The soft sand-stone becomes indurated as soon as bared, and is not much eroded by the wash of the water.

It is as I said a romantic place. Just below is Fort Snelling, on a high picturesque bluff or "butte" as they would say in California, and there are the falls of "Minnehaha," which next to Minneapolis is the farthest from euphony that the namers could get. These falls are on the Minnetonka River, or creek, the waste-way for Lake Minnetonka, a dozen miles away, and here comes in a fish story,

the first I believe in these notes, and happily so, as it might have cast a doubt over their "petrified truth," as Mark Twain would say.

My Uncle had an engagement to look over the retaining works at the falls with some civil engineers, and as I never took much interest in static structures of any kind I concluded to go out to lake Minnetonka with a picnic party of some local society. I was a stranger, knew no one and dropped into the procession mechanically. At the lake as soon as the train stopped, people scattered every way, some to a steamer, some to hotels, and many out in boats, until I stood alone staring around for company, then started to wander around the north side of the lake.

I came shortly upon an old Noah who was pitching a punt he had been caulking, and asked him where I could get a skiff? "All out," said he. "Good day for pickerel." This excited my interest at once, and I encouraged the dialogue.

"Pickerel, that is the same as pike, fine fish, and plenty in the lake, but them fellers can't catch 'em," said the boat-man, twirling his thumb toward a whole fleet of boats out in the lake trolling with long lines, "No pickerel out there, only some fool half-grown ones. The old chaps are lying in the shade along in shore next the grass (bulrushes)." I soon struck up a bargain, with a dollar on one side, the old punt, and a trolling line about three hundred yards long, spoon hook and tackle, on the other side. "Now," said the old chap, "I must go to town, don't mind them dern fools, just you go down round the grass there on the shady side, keep close in, hold the line in your teeth so you can row and feel; keep close in and you'll get more fish than the whole lot of them town fellers."

I had never seen a pickerel, never held a troll line, but had fished a good deal, and would have made a small bet there was not a fish six inches long within five miles of there. I started out, run out the long slim line, took it in my teeth and rowed along "close in." Directly the spoon hook caught, I knew it would, and it came near hauling me over the stern of the boat. I dropped the oars and grabbed the line, when away back, at least a hundred yards, an agile fish sprang into the air in a curve, and disappeared. A tugging at the line, and the idea at last burst upon me, "I have hooked a fish!" Oh the excitement! I hauled him in; about three pounds weight, and then went "into business."

The old boat-man was right. By keeping in and dragging the troll around the rushes I captured nine fish. All I could carry,

and when the people collected to go home, here was I with the only catch worth considering. I had a thousand questions to answer, and on the way in, laid down to old fishermen the laws of pickerel fishing: "shady side, close in, bulrushes and the rest."

My Uncle met the train, and was amazed at the fish. "Where did you get 'em, Tech?" said he. "Out at the Lake," I answered, but no mention of my catching them. Oh no, my Uncle was too astute for such a story. I have not ventured it but a few times since, and never nearer than a thousand miles from Lake Minnetonka. There is a mental reserve about its incorporation here without an affidavit.

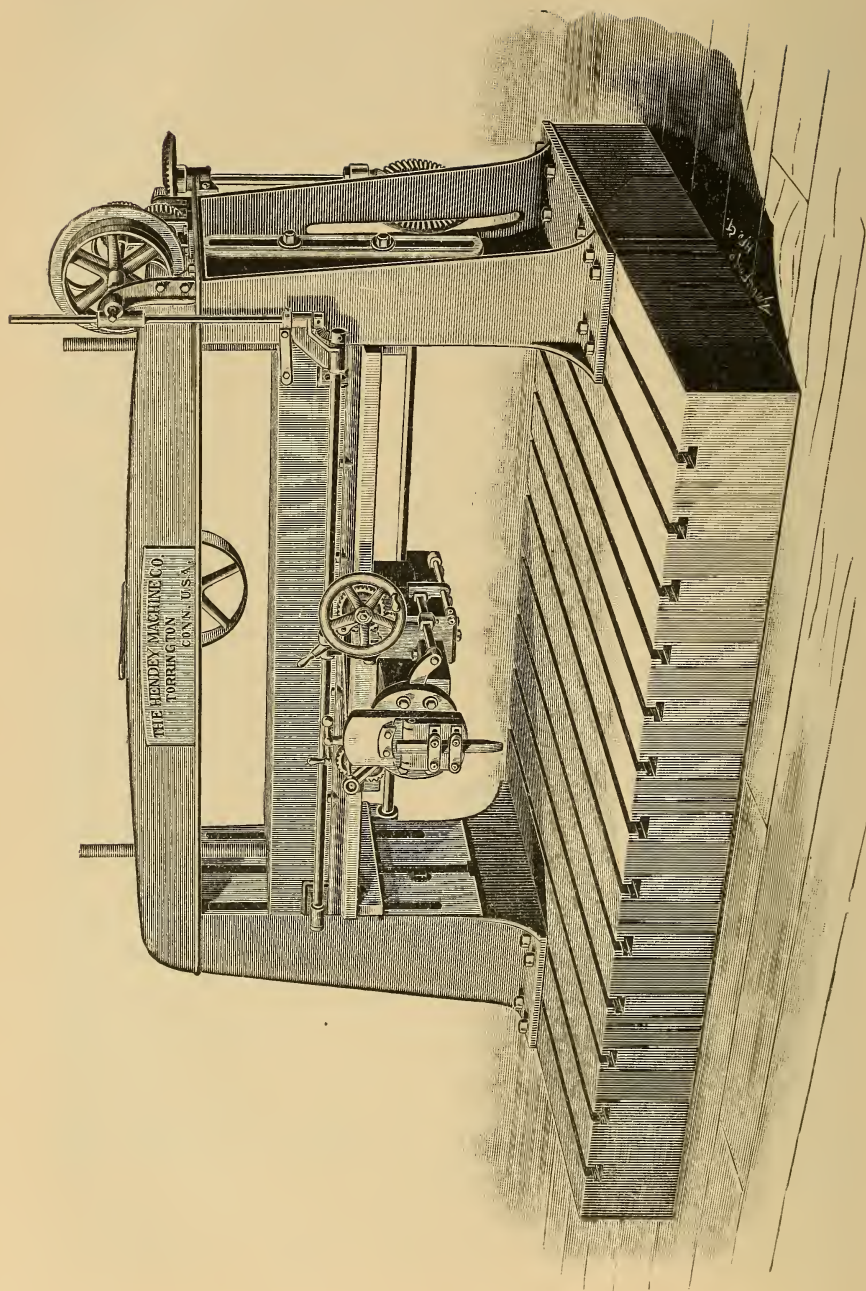
—————There is one hope of Minneapolis. It is only three miles from St. Paul, or counting suburbs less than two miles, and built all along the way, so it is to be hoped that St. Paul will some day swallow the Indio-Greek town and spread its name over all.

St. Paul is a solid old city, old as cities go in this land, and is the head of navigation on the Mississippi River. From here to the falls, three miles or so, is a succession of shoals and rapids. There is a projected canal, as there is everywhere at this day. There is good reason for one here however where they make 9,500,000 barrels of flour in a year, and saw a large amount of timber, besides ship a world of wheat and other products from the Falls.

—————Going down to St. Paul, my Uncle pointed out some fruit trees on the way, and said, "Tech, set down in that note-book of yours that vegetable life like animal life becomes acclimated, otherwise you may write that the first settlers here were fools. They thought nothing would or could grow up here because it was so cold. Wheat for bread was carried up from St. Louis, and now it is a wheat country. Fruit was not thought of, except some little wild plums about the size of olives, and the orchards were confined to Siberian crab-apples. These little red fellows looked delicious, and became edible after being well frozen and compounded with an equal weight of strong sugar. That myth lasted twenty years or more, and then apples, pears and other hard-wood fruit trees were planted and thrived, not at once but gradually.

"It is cold here, terribly cold in the winter, and hot in the summer, but that don't matter, climate is to people an accident. The harsher it is the more they admire it."

(To be Continued.)



A NEW PLANING MACHINE.—THE HENDEY MACHINE CO., TORRINGTON, CONN.

A NEW PLANING MACHINE.

THE HENDEY MACHINE CO., TORRINGTON, CONN.

The machine shown in the drawing on the opposite page is typical of a tendency, or "trend," we may call it, in metal planing that began about twenty years ago, and has made slow but sure progress ever since, that of moving tools instead of moving the material.

An analysis of the two methods will show many advantages in favor of moving tools when large masses are planed, and as the original cost of machines, as well as rapidity of performance and perfection of the work, are all in favor of "moving tools," the wonder is that change to this system has not been more rapid.

An old rule is that when two masses are to be moved relatively, move the lightest one, holds good here, and when it comes to dragging tons of metal backward and forward on a table weighing many more tons, to plane off a few spots on the side or top, the operation seems ridiculous. We have not, however, space to discuss this subject here. It is suggested by the machine shown, which consists of a reciprocating tool-bar suspended and traversing laterally over a width of seven feet. The machine was at first constructed by the Hendey Machine Company for a special purpose, and, as in a good many other cases of the kind, its general utility was discovered by experience, and it is now made and classed as a standard implement.

The machine is made with massive proportions, as the drawing shows, and is provided with all the required adjustments for rapid working. The piece or mass to be planed is bolted down to the bed, the tools having a compound traverse motion over the top, and are, we imagine, a good deal more rigidly supported than in a common planing machine. The weight of the one shown is 25,000 pounds. It is proposed to illustrate in a future number some other special machine tools made by this Company.

KINETIC STABILITY.

Robert Stevenson, C. E., of Glasgow, a pupil of Prof. Rankine's, recently lectured before the Academy of Sciences, in this City, on "kinetic stability" of masses in rapid motion, or on the theory of gravitation, and as the secular press, and even the scien-

tific press has claimed, disputed the Newtonian law of gravitation. Mr. Stevenson has done no such thing, but has controverted Newton's theory of "attraction," which is a very different matter, and has attempted an analysis of the elementary forces that lie at the bottom of gravitation, including kinetic stability, that, not only in his mind but in the minds of nearly all scientific men, is clothed in doubt, and fails to satisfy the phenomena of physics.

By "kinetic stability" is meant the tendency of bodies in rapid motion to continue in one plane, a phenomenon of which we have a familiar illustration in a spinning top. If a top when in motion is deflected from its plane of rotation, it will when released at once regain the original plane, the same thing appears in a gyroscope. This tendency to remain in or regain the original plane of motion is what is meant by "kinetic stability." Those who write flippantly of this matter do not know or understand what the lecturer is treating upon, and what is by no means a new subject. As before said, is not one that he alone has given attention.

We have not read Mr. Stevenson's paper, consequently do not pretend to comment upon it further than to point out that it is not, as we understand it, to controvert the law of gravitation as laid down in the *Principia*, but an attempt to settle that law on a foundation that will corelate with other physical phenomena of nature, which the theory of attraction of masses does not do, and which Newton himself never accepted with complete confidence.

ANOTHER GREAT PIPE LINE.

Messrs. Francis Smith & Co., of this City, are now carrying out their contract for making and laying a large pipe from Alvarado to Oakland, in Alameda County, in a very rapid manner, completing about 800 feet daily, which is wonderful work for a pipe of such large dimensions.

A 30-inch pipe will extend from the artesian wells at Alvarado to 23rd Avenue, Oakland, and then continue 20 inches bore from there to Oak Street, in all a distance of 22 miles. The whole scheme would be a matter of amazement to our Eastern friends. A complete plant for preparing and coating the pipes was erected at San Leandro, a half way-point, and when one considers what 800 feet of

pipe 30 inches bore, of No. 10 iron, involves, including both making and laying, the celerity of the work is astonishing.

We have been over a portion of the line and examined the work, which seems to be done with great care and in a very perfect manner. A citizen on the road in the morning finds in front of his house a great ditch and mound of earth, and on his return home in the evening only a low ridge marking the completed line. Machinery is employed in excavating and filling, and the work goes on with a regularity and order not often seen.

The Oakland Water Company, for whom the pipe line is being laid, propose to bring water from the artesian wells at Alvarado, and will, no doubt, find the supply permanent. Tunnels at the mountain tops are an uncertain source, apt to "run off" in time, but not so with artesian water. The Alvarado wells, like those at Sonoma, and in the southern counties, prove a constant source of supply. Messrs. Francis Smith & Co. expect to have the whole 22 miles in use by November, and at the present rate there is no doubt of the whole work being done at that time.

THE TECHNICAL SOCIETY OF THE PACIFIC COAST.

This Society held its regular meeting on July 6th. Consulting engineer, Mr. Isaac Tipping, of Victoria, Australia, was elected a member of the Society. A technical paper on "High Masonry Dams," prepared by Mr. J. Carroll, was read and filed among the contributions, no discussion following.

There was then a discussion directed to the topical question: "Has the time arrived when our Patent Laws should be abolished or modified to suit the present condition of the mechanic arts?" We have not received in time for insertion in its proper place, the stenographic report of this discussion, except the part by Mr. Richards, printed elsewhere. Farther notice of this discussion must therefore be deferred until next month.

THE WOOD-PLANING MACHINE PROBLEM.

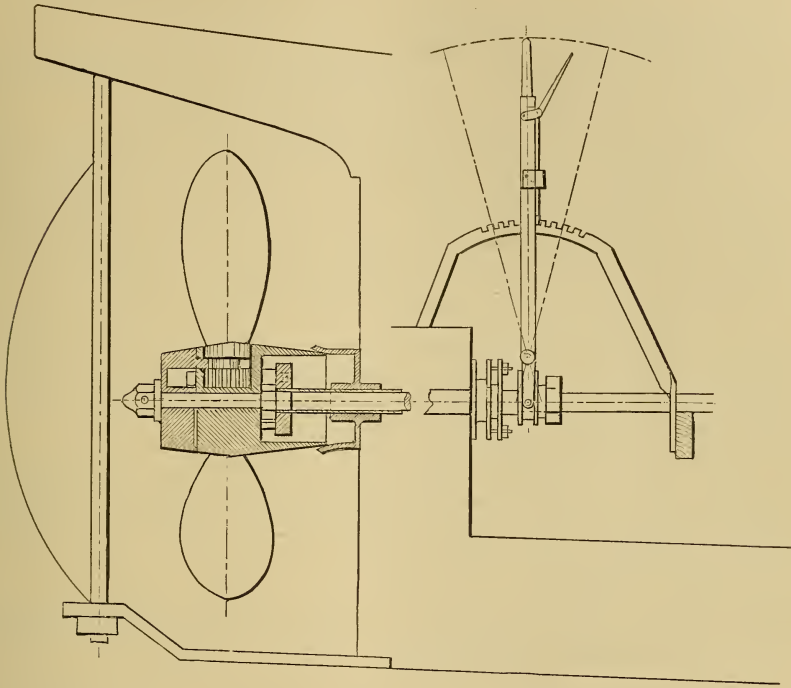
In a late number of the *Woodworker* we note another, the third, planing machine recently produced with a bottom cutter to act first. There will be more of them, and further on we will, no doubt, find

the vertical spindles moved back behind the top cutters, and the rear under-cutting head omitted. Then our makers can go out into the markets of the world and sell planing and moulding machines as they do now mortising, tenoning and other wood-working machines.

The quantity of machines of this class that can be sold when arranged in this manner will not be the principal fact; that will be the influence on the general trade. It is wonderful that American makers have met with such success, as now appears, in selling a large quantity of wood-working machines in foreign countries to people who believe and know that our principal machines, those for rotary planing, are made wrong end foremost, gauge from the "back" of the timber, thickness the piece first thing, and cast the shavings all over the side, heads and feed rolls.

Referring to the last machine illustrated, one made by Messrs. Goodell and Waters, at Philadelphia, it seems a very good one, but there is a query respecting the under cylinder at the rear end of the machine, unless it is put there from force of habit. We have seen machines fitted with circular saws on a rear spindle to divide mouldings without the waste that occurs when the top or profile cutters are arranged to cut through. One such machine was to make "map mouldings," small bars, of which six were worked at one time.

In a late number of *INDUSTRY* we had occasion to mention the fact that there were larger saw mills in the Old World than any in this country, and have received some inquiries in the matter. The largest mill so far as known, is in Christiana, Norway, where one million feet is produced daily. Mr. Charles Hanson, of this City, visited this mill some years ago, and described it in an article furnished to the press. There are about thirty gang saws and six planing and matching machines, the latter of the massive Norwegian design which feed at a rate of 80 to a 100 feet per minute. The timber is all seasoned or dried before it is sent away, and, as Mr. Hanson says, is sawn much more carefully and planed smoother than here. This is stating it "mildly." Mr. Hanson is himself an extensive owner of mills here, and has one at Tacoma that turns out 500,000 feet a day, otherwise would perhaps have added "infinitely" to the adjective above. The consumption of timber in Great Britain alone is 3,700,000,000 feet a year, and the forests of Norway are estimated as good for 500 years to come.



REVERSING SCREW PROPELLERS.

S. G. HINDES, SAN FRANCISCO.

The history of feathering or reversing propellers is becoming a long one. The objects to be attained are especially desirable, and the means or mechanism for its accomplishment admits of an endless array of contrivances, and some of them produced have been absurd from a mechanical point of view. Mr. Dickie, of the Union Iron Works, says that when he sees a countryman approaching him with a roll of papers under his arm he knows there is a new propeller of some kind to be discussed.

The objects of a reversible propeller are: (1) to permit the driving power to run on continuously in one direction, the reversing function being shifted from the engine to the propeller blades; (2) the act of reversing is rendered instantaneous, a very important matter, especially in the case of small boats; (3) control of the pitch, or convolution of the vanes, so as to adapt the propeller to variations of speed and power. Either of these things is enough

alone to call out effort in the way of contriving reversible propellers. The gas engines, which are not reversible for various reasons we will not discuss here, and their extensive application to propulsion has given new interest to reversible apparatus, but thus far mainly for the screw shaft, or between the engine and propeller.

In England, Mr. McGlasson has devoted some years to this subject of reversible propeller vauves, and has fitted up successfully a number of boats of small power. On the Continent too there have been a number of inventions, but the present one, it seems to us, is the most simple and complete that has appeared.

Mr. Hindes, who is a mechanic and an engineer, wisely went to work to reduce the required mechanical elements to their most simple form, namely, cylindrical shanks for the vanes provided with toothed sectors engaged by racks operated by a sleeve around the screw shaft passing through the stern bearing.

This seems all simple enough, and had been done or attempted before, but in a different manner, as will now appear. To secure lateral stability of the vanes within the limits of the boss or hub has been one difficulty. This stability Mr. Hindes secures by constituting the toothed section of the stem a portion of the bearing, which, as seen in the drawing, extends the whole distance from the shaft to the periphery of the boss. Then to provide for what may be called fulcrum wear he cuts away the neutral or central part of the bearing, employing the space or groove thus provided as a collar channel to hold the stem longitudinally and resist centrifugal force. Detents or half collars fitting into these grooves are formed integrally with the cap on the end of the boss, so that as soon as this is removed the vanes are free.

We mention these things as principal features. There are many more, but, as a whole, we think the inventor has gone back to "first principles," so to speak, and reduced the various elements to their most simple form, and with correct proportions. We have practically seen and handled the propeller, and must admit there are many favorable results that would not be suspected inferentially. There is absolute control of a boat the same as if the operator was using a pair of oars, and the analogy holds good down to turning the boat as if it were on a pivot. This is done by reversing the screw and setting the tiller accordingly.

Mr. Hindes is now engaged in carrying on practical experiments with his propellers, and will soon determine final proportions and arrangement so as to prepare standard drawings for various sizes.

LITERATURE.

University of Minnesota.

The Quarterly Bulletin of the University of Minnesota, for June, is at hand, and continues as the foremost publication of the kind in this country. In this remark we include subject matter, dress, paper, and general make-up.

The present number is characterized by great diversity, the topics being literary, scientific and technical, and in each department showing original research instead of compilation.

An extensive law department, and buildings therefor, has been added to the facilities, and an appropriation of \$175,000 was made for that purpose in 1893. Minnesota is a State of schools, having from the beginning laid a broad, deep foundation, both of resources and sentiment, in favor of education.

Report of the City Engineer, Omaha, for 1893.

We are favored with a copy of the above report, by Mr. Andrew Rosewater, city engineer, Omaha, Nebraska, and must admit an activity there that one will hardly suspect. The expenditures in the engineering department last year were \$843,231, which for a western city of 150,000 inhabitants is certainly liberal, and indicates a public spirit that assures a prosperous future for that city. The report is accompanied by a number of well-finished maps, colored to show paving, sewer work, lighting, the water system, etc., but the part with which we have the most concern is the section headed "The Platte River Power Canal."

This river at a distance of thirty miles from Omaha is 222 feet above the Missouri, and 189 feet above a level of possible discharge in that city. The Platte River at the point named has a fall of five feet per mile, and in September and October, the driest months, affords a volume of 22,000 feet per second. This water it is proposed to bring to a point seven miles from Omaha. At first

a private company took it in hand, and after surveys and estimates turned the work over to the city. A vote to issue bonds to the amount of \$1,500,000 was decided against the issue, and wisely too, no doubt, for the present, because the scheme is yet too new to have the advantage of well-matured plans.

The part of the Engineer's report relating to this scheme, that will attract most attention, is the carefully collected data respecting means of transmitting and distributing power from the proposed place of generating, seven miles from the city.

Mr. Rosewater concludes, after careful computation of electric, hydraulic, and air transmission, that the latter is best and cheapest, by a difference of 15 per cent. or more, compared with electric transmission, and appends reports of Mr. Robert Gilham, C. E., on the Birmingham, England, and Paris pneumatic systems, to show the successful working in these cases. The significance of this section of Mr. Rosewater's report lies in the great change it indicates in the economies of air transmission, developed in ten years past.

Michigan Annual Report of the State Bureau of Labor for 1893.

We have for a number of years past had occasion to call attention to the Annual Reports of the above-named Bureau, and in respect to the last one claimed that Commissioner Robinson's methods should be carried into the National labor statistics. This has, we believe, come about, and he has left an able successor in Mr. Charles M. Morse, the present Commissioner in Michigan.

The methods there have not been an annual *olla podrida*, but a concentration upon one thing each year, which is treated exhaustively and finally, because the circumstances of industrial economy and labor do not change much from year to year.

Last year, as will be remembered, the Michigan Bureau investigated female labor. This year the subject is railway labor, and the result will be in the end that the reports

will form an orderly and classified library of labor statistics.

There is an appendix, it may be called, in which is reviewed strikes, effect of business depression, convict labor, building and loan societies, and recent laws relating to labor, but the main part is an analysis of railway labor.

Twenty-three railways were canvassed in preparing the tables. The number employed is 27,956, and the number applied to for information was 9,226, or one third of the whole. The columns in the tables include nearly every conceivable fact from which economic conclusions could be drawn, even to some hundreds of letters given literally as received from the writers, reflecting in the fullest manner prevalent opinions of the men in railway employ. These letters, Commissioner Morse says, "are submitted without editing, selection, or apology." A consensus of them is not flattering to the economic policy and social conditions of our time.

The average wages paid are: for conductors, \$72.87 per month; engineers, \$87.75; firemen, \$49.78; brakemen, \$48.53; agents, \$46.10; clerks, \$47.02; laborers, \$35.35.

This we think does not much exceed rates in Great Britain; the most astonishing case being that of agents, men entrusted with money, accounts, and responsible business. This comes from competition and the assumption that anyone can discharge the duties of a railway agent.

Hydraulic Power and Hydraulic Machinery.

BY PROF. HENRY ROBINSON, KING'S COLLEGE, LONDON.

This work is sent by The J. B. Lippincott Co., of Philadelphia, the publishers in this country.

Works on hydraulics are always welcome. The art, to so call it, has not a redundant literature, in the sense of its covering the enormous field that is now comprehended by that flexible term, and is by far too much confined to disputes and essays on minute differences of constants and co-efficients in formulae amounting to the proverbial difference between "tweedledee and tweedledum."

The present treatise, while taking sufficient and ample notice of what may be called hydraulic conditions, twenty-two pages being devoted to the flow of water in pipes,

the main object is to set out and explain applications of hydraulic apparatus. In the section on flow are given some newly constructed diagrams, correct no doubt to the limit imposed by the varying conditions of pipes, but this section, as before remarked, has not the interest, or use even, of the remaining two hundred pages.

There are 69 plates and 54 engravings employed in illustration, and selected in nearly all cases from actual practice. The heads of subjects number 221, which indicates the wide range gone over.

Among the subjects treated, some are of peculiar interest at this time. Forging presses; Pearsal's hydraulic engine; the Greathead shield; The Venturi and Deacon's water meters, with various examples of water-elevating machinery, may be named. Deacon's water meter, treated of in the last article, suggests a ready and cheap means of measuring the flow of water here in California.

The principal value of the present work will appear as a reference in engineering works, and for constructing engineers and draughtsmen. The drawings given of various machines are geometrical and to scale, and the examples are chosen from standard modern practice.

The practical nature of the work is indicated by the fact that the author was formerly assistant to Sir William Armstrong, who is called the originator of the high-pressure hydraulic system.

The price is \$10.00.

Gas and Oil Engines.

We have had frequent inquiries for a treatise on gas engines, and in answer have been sending or recommending Professor Robinson's work on this subject. Now a new one appears, by Mr. Bryan Donkin, an English engineer of high standing, and the work is assuredly complete and up to date. The author is not concerned in making or selling gas engines, and his researches are impartial beyond doubt. Not many copies have reached this country yet, and a further notice will appear when the book is examined. It is published in England by Charles Griffin & Co. In this country no publisher is announced at this time.

Electricity a Hundred Years Ago and To-day.

Prof. E. I. Houston has written, and the W. J. Johnston Co., of New York, have published, a small book under the above title that will no doubt meet with wide appreciation and sale. It is to electric literature what Smiles' "Industrial Biography" was to engineering literature—a relief from x , y , z —a book from the outside, that everyone can participate in.

It is mainly a popular lecture by Professor Houston, with the data on which the lecture was founded added to the present text, a wonderful quantity of curious things, historical and otherwise, gathered up and considered from a modern standpoint in electrical art. It is not quite easy to class or describe the book. There is not, that we know of, another more deftly planned to engage the reader's attention, and at the same time instruct him.

In an appendix, Professor Houston in alluding to Lord Bacon, has the fairness to not ascribe a renaissance of the inductive and scientific method of research to a man who rejected the Copernican system and disparaged mathematics. If such a claim is to be given to any one person, as Dr. William Draper contends, Leonardo Da Vinci has a just right to that distinction.

The book contains 200 pages, and is sold for one dollar.

Federal Cases.

The West Publishing Co., of St. Paul, Minnesota, have devised or invented a new system of editing and collating Federal law cases, and have arranged and revised according to their system, the whole procedure, so far as of value, from 1789 to 1890, reducing the whole from 150 to 33 volumes, and the shelf room required from 30 feet to 8 feet. Specimen pages sent show very ingenious and at the same time compendious and complete classification. The cost of the edition will be about \$275.

The American Chemical Journal.

VOL. XVI, No. 6.

The present number of this publication, which should be No. 186, comes to hand this month with an interesting essay on the

"Oxidation and Properties of Gases," including especially petroleum or natural gas.

The Johns Hopkins University has the first place among American educational institutions, and thoroughness is the characteristic of its teaching and publications of all kinds.

Country Roads.

ISAAC B. POTTER, NEW YORK.

Mr. Potter, who fortunately has the resources to do so, is making a campaign against the abominable roads, or the places roads ought to be, in this country, and is publishing a series of essays called "Potter's Good Roads Library," at ten cents a copy, or less than the cost of paper and print. The present number, for June and July, of 1894, is quite enough for one installment. It should make people blush for shame. There are numerous engravings made from photographs, and the subjects are beyond description. There is a wonderful fund of information of all kinds pertaining to roads, and the pamphlet is worth a hundred times the money.

These books can be procured from Mr. Potter, Potter Building, New York.

The Clear Lake Electric Co.

Mr. James Armstrong, of this City, one of the directors of the above company, sends us the first report upon the main engineering features of this important scheme, including various circumstances pertaining to cost and the commercial phases involved. We cannot in our present issue do much more than acknowledge the receipt of this very complete prospectus, leaving the facts and quantities for more extensive notice in our next issue.

At present we will merely note that the proposition is to utilize the water of Clear Lake, situated 1,317 feet above the ocean, in Lake County, 75 miles from San Francisco. The lake has but one outlet called Cache Creek, which in $12\frac{1}{2}$ miles affords an available fall of 454 feet. The volume of water is estimated from several measurements at 500 cubic feet per second, equal to 25,000 horse-power. This it is proposed to convey at high voltage over wires to San Francisco and other points along the line.

LOCAL NOTES.

The present number begins the seventh year of INDUSTRY—the seventy-third issue, which if rated in the common manner would be Vol. XV. There are no “Volumes” of INDUSTRY. An index is published yearly, so the matter, about 1,000 pages, will form a convenient book. No factitious means have been employed to build up or sustain the Journal; no parade of flattering letters; no premiums or bribes; not one cent has ever been received for the use of any but advertising pages, and the future will be fought out on the same line. Flattering proposals to transplant INDUSTRY to a wider field have been passed over; it has remained faithful to the original plan and is a proof of acceptance and faith in honest publication of what is thought to be true and for the greatest good. No one has been wronged knowingly; no favoritism shown and none asked. The Journal is a business enterprise, but has not been hampered by business conditions. It may “die” but will not “decline,” and on these grounds it seeks a fair support in a field faithfully served. The main object in this personal notice is to ask our readers to look back over six years and see the proportion of error and truth, also what the influence and effects of INDUSTRY have been on the Pacific Coast.

The failure to receive mailed matter during most of the time when this Journal is made up, from the first to the twentieth of each month, has modified to a great extent the character of this issue. Our exchanges, nearly one hundred in number, are not at hand, engravings are somewhere *en route* or lost. There is the advantage of bringing to mind the circumstances of a large part of the world that lies without the zone of telegraphic and daily mails, and if continued would have at least the effect of increasing attention to local matters. This our contemporaries do to a greater extent than this Journal, hence we suffer most by being cut off. Some acquaintance gained of various industries in Europe by residence and participation there, also in various parts of our country, has enabled INDUSTRY to present facts and opinions of most new inventions and changes in the arts as soon as these were worthy of notice, but for this month paucity of such information must be expected.

In another place we speak of the rapid building of the North Pacific Coast Steamer *Sausalito*. Mr. John Dickie, of this City, who had charge of constructing the hull of this steamer, informs us that the most rapid work, all things considered, ever done on this Coast, was the bark-rigged steam whaling ship *Baelena*, built about ten years ago, complete in eighty days. The steamer was of 600 tons, completely fitted out with triple-expansion engines, oil tanks and all kinds of whaling tackle. She was built at the Potrero, by Dickie Bros., and is one of quite a fleet of such steamers constructed by the same firm and owned in this port by the Arctic Oil Co.

Mr. Towne, in one of his press communications, anent the great strike, sets forth the inconsistency of his men striking because of supposed grievances of workmen in the Pullman shops, 2,000 miles away. This is incomprehensible to a good many people, but our advice is, in organizing anew, that these are the very men that Mr. Towne should set at work. A man who will thus make common cause with other men he has never seen, 2,000 miles away, throw up a lucrative position as a matter of principle, is the man to employ. It is the "what's that to me" class of people who are ruining this country, and the very spirit that prompted the strike here on account of the Pullman men is likely to be the foundation of loyal service, as Mr. Towne and all others will find. The strike may be mistaken and wrong, but these are the kind of men most capable of rendering true and faithful service.

The *Marine Review*, Cleveland, Ohio, has, with commendable enterprise, published a double number for June 30th, containing, besides a large number of engraved drawings of the great passenger steamer *Northwest*, fourteen pages of finely-executed photo-plates illustrating that vessel. The *Northwest* is perhaps the finest passenger steamer ever constructed in any country, and is well worth the expense incurred in the present case to show the public what she really is. The appointments throughout in all departments are of the highest class known to modern skill and art, are marvelous indeed, and quite beyond any description possible here. The ship is 383 feet long, 7,000 horse power, 4,244 tons, carries 442 cabin passengers, and a total of 800, crew and passengers. She is to run

for passengers exclusively, between Buffalo and Duluth, in connection with "Jim Hill's" railway, the Great Northern, and will, we predict, carry a great share of the travel to the Northwest. Those interested in ships and shipbuilding should not fail to procure a copy of the *Marine Review* for the date above given. The price is 50 cents.

The Government has ordered a test of the different kinds of coal found in Washington, and detached the *Monterey*, war steamer, to make these tests. It would have been much cheaper, and a good deal more conclusive, to have sent examples of the coal to a reliable laboratory for analysis. A test in a war steamer is an uncertain matter, especially if environed by circumstances such as have attended on the coal supply at Mare Island in times past. The qualities of Washington coal are pretty well known now, and there is not a dealer or user in this City, or elsewhere, that will give much attention to the *Monterey* experiments, or be influenced thereby. The commercial acceptance of coal is the true gauge of its value, is indeed the summing up of thousands of experiments, of which that on the *Monterey* will be but one.

The Commercial Publishing Company issue each year an annual of the *Commercial News*, heretofore a statistical pamphlet giving a summary of the commerce at this port, and of shipping, that serves as a useful reference throughout the year. For 1894 this annual has taken on a new form and is preceded by 28 pages of finely illustrated matter, 10 × 15 inches, descriptive of various prominent works in the Bay cities. There are more than forty fine photographs accompanied by well written descriptive text. The articles on water transport in the Bay, rivers and estuaries, should cause some thinking and some regret. In the case of Napa, for example, Napa County voted about \$200,000 of bonds to promote the building of a railway up the valley which changed the city of Napa "from a sea-port to a railway station," as the writer describes it. There are essays on the Nicaragua Canal and other topics of current interest. Copies can be procured from the Commercial News Co., at 34 California Street, in this city.

COMMENTS.

Professor William D. Whitney died at New Haven, Conn., on the 7th of June last, and in him passed away a man who is, perhaps, foremost in the annals of American scholarship. It is claimed, and fairly too no doubt, that Prof. Whitney was the foremost Sanscrit scholar of our age, and the one American philologist who took rank with any in the world. A claim such as this many years ago aroused the ire of Professor Max Müller, who so far forgot his position as to abuse Professor Whitney by carping criticisms of his writings and views. Of this the Professor took no notice, much to his credit and much to Professor Müller's damage. Professor Whitney was elected an honorary member of the Asiatic Society of Bengal, the Royal Asiatic Society of Great Britain and Ireland, the German Oriental Society, the Philological Society of London, the Academies of Berlin, St. Petersburg and Rome, the Institute of France, but, most conspicuous of all, was elected a Foreign Knight of the Prussian Order of Science and Arts to fill the vacancy caused by the death of Thomas Carlyle. He was Professor of Philology in Yale College, and 67 years old at the time of his death.

The Hon. W. E. Chandler, of Naval Secretary fame, has introduced in Congress a Bill to improve the spelling in public documents, that is for the Government printing office. A kindly care of all the people's interests by Congress demand a reform in spelling as well as in the prices of things, and whatever concerns the citizens, but there is somewhere "a nigger in the wood pile." That can be depended upon. The proposition is to spell phonetically in printing government documents, and the proposition is about as absurd as one can well be imagined, because such an innovation, when it does come, will originate elsewhere than in Congress, although its greatest usefulness may be there where spelling is no doubt a serious impediment to those writing and correcting long speeches. The Pitmans have a long history of wasted energy in attempting to introduce reform in our absurd system of spelling, and abandoned the work in this country, but have kept on in England, where a good deal more progress has been made. An Act of Congress is, however, a new line of attack, and it remains to be seen what can be done when trade and some other present problems are disposed of by that body.

There is not one American in ten that will not on sober reflection indorse the traditional policy of this country of keeping out of foreign entanglements and alliances. Meddling policy is an outgrowth of what is called in England "jingoism," dumb show for effect, and commonly adverse effect in the end. We have now two of these cases in hand, one in Hawaii, for which there is remote excuse, and one in Samoa, where there is no excuse at all. A tripartite alliance was entered into with Great Britain and Germany to guarantee some kind of government there, and now comes the result, that of continual unrest and disturbance in the islands, which we are responsible for to the amount of one third, with no compensating advantage whatever. Out of nearly 300 vessels landing at Samoa in 1887 we had six, and the cargoes footed up \$60,000 in value, the profits of which would not furnish coal to drive a cruiser out to the islands and back.

In the claim filed against the Stanford estate on the grounds of misappropriation of the earnings of the Central Pacific Railway, and their evident intention of not paying the debt of about 78 millions of dollars now falling due to the Government, and still more notably the House and Senate Bills of Senator White and Congressman Maguire to prevent the further issue of land patents to defaulting railway companies, is seen the beginning of a policy that must stop such wholesale waste of public funds. The General Government, with all of its pretended powers, is being employed as a means of promoting private interests, not only by land grants and money subsidies but in taxation by duties on special commodities. It is all of one nature, and that "nature" is one man eating another's bread, a broad system of inequality that will have to come to an end, if not on moral grounds, then by necessity. We have been rich enough to stand almost anything, but the National purse has a bottom, now well in view.

In respect to those "granted" lands, they are held by the Government, defended and cared for, until the railway companies can sell them to advantage. Then they are "patented," or formally turned over. The object is to avoid taxation. All other property has to bear its proportion of taxation, but in this case the railway company is put on the same footing as the Government. They "own" the land, but the donor keeps it until wanted. Fortunately, however, this Act of Patenting constitutes transfer, and as only about one fourth of the grant to the Central Pacific Com-

pany has been patented, there is an easy way to save to the people some part of the money that should be returned to the National Treasury. We think the cession of lands in such case or in any case is an outrage of public rights, a power that Congress should not be permitted to exercise.

The recent decision of the United States Superior Court in respect to mineral lands covered by railway grants is esteemed a very important matter, not because it enunciates any new principle of law or procedure, but because it indicates some bounds to the pretensions of subsidized railway lines. There never has been a question of the reservation of mineral rights in the case of Government titles or patents to lands except in the case of railway grants, and certainly their case should not be made an exception. In the case of the Northern Pacific Railway, in the suit above alluded to, mineral lands are reserved in the Act of Congress granting a subsidy equal to 40 square miles of land for every mile of road built, and this one would think quite enough. "Jim Hill" succeeded in building a parallel line without land subsidy, and a better line too, if accounts of it are correct. The Northern Pacific Railway is not in a position to urge extraordinary claims on any grounds the public are aware of.

Mr. F. A. Walker, of Chicago, an eminent lawyer there, writes in the *Forum* for April, on the Inter-State Commerce Law, and among other things mentions the irrelevancy of the name. The law does not relate to commerce, but to railways, and has for its main object the regulation of rates for carriage. We sometimes laugh at the descriptive terminology adopted by the British Parliament to define laws, but the rule is correct. Mr. Walker's opinion that this Act is a crude one, wanting in its constructive features, will find wide endorsement. The "Commission," having both the functions of prosecutors and judges for one thing, is anomalous, not to say stupid, when, as now appears, their powers have, by the action of the courts, been restricted to what may be called "reporting cases." The array of statistics published each year have little interest or use to the public, and for other work it has proved a failure, like all legislation to "regulate commerce," which, like the weather, is not amenable to the statutes.

The *Minneapolis* war cruiser has attained on her trial trip a phenomenal speed. This vessel is provided with three screws, on the method proposed some years ago by Commodore Melville, and cost \$2,690,000 by contract, and now by speed premium will cost about \$400,000 more. The length is 411 feet; beam, 58 feet; draught, 24 feet; displacement, 7,350 tons; horse power, 20,000. The speed reported is 22.81 knots. In the case of this vessel, and the *Columbia* also, it appears that the efficiency of the screws, or in other words the effect of the indicated power, is greater than if applied on propellers of greater diameter, which is possible and will bring up a new phase in this vexed problem. There is an old saying, "that the more the haste the less the speed," and in the case of war vessels there may be applied a similar adage "the more machinery the less speed." How so complex a contrivance as a modern war vessel is to be kept going is to be a problem of the future.

It is an æsthetic view to hold that there should be no "cakes and ale" at a congress or convention of scientific folk, but is tolerably good sense. Out of the whole number attending a convention of engineers, for example, there is probably not one in five that would choose a banquet as the best way to spend the money that such entertainment costs, and these would be the speechmakers mostly. It is an English idea, this correlation between the mind and the stomach. There everything begins with dining, and one must admit they manage very well, but here in this country the resources are not so great, and less money available, but we spend more in entertainment. A guinea a plate makes a fine banquet in England, but it takes at least twice as much here. In 1875 the Master Car Builders adopted the following resolution; whether it has been carried out or not we do not know:

"We desire by this resolution, first, to express our thanks for the liberality of our friends in the past; and, secondly, to make the request in this public way that in the future there shall be no more expenditure of money for the public entertainment of members of this Association."

Not content with the 50,000 words in common use in our language, people have invented a new one, "onto." This was because of the scarcity of prepositions, no doubt, and done to balance up the parts of speech, because when anything is "on" it is certainly "to." It is a companion word to "unto," which has

dropped out of use since the time of James I. The "to" part is superfluous, and even if there was euphony to recommend it, that is not sufficient for adding to the redundant vocabulary of our tongue. Those who would learn the proper use of English must read authors who have written in that language so as to display its powers. Beauty it has not. Among such authors are Adam Smith, Thomas Buckle, Addison, Kossuth, John Bright, Irving and Mr. Gladstone. For manipulation of the tongue no one has approached Carlyle. He is always grammatical, and does not use slang. At our day there is no one who can excel Ambrose Bierce in deft use of our language. He too is grammatical always, and his knowledge of words marvelous.

ENGINEERING NOTES.

The rate at which sand is raised and removed from the Mersey bar, at Liverpool, shows that a port can be shoveled out almost anywhere. The whole amount removed last year is estimated at 2,250,000 tons, two thirds of it in six months, mainly by one dredger, which raised 135,000 tons a week from water 20 feet deep, sometimes raising at the rate of 4,000 tons an hour. It is a centrifugal or suction machine, full powered for steaming, and runs away to discharge the load as soon as the immense hoppers are filled. The channel being dredged is 1,000 feet wide and 20 feet deep. There has been a great deal learned there of sand dredging. At first the work went on slowly, but now the rate is such, and the expense so little, that for the future deepening channels in sand will be a small matter.

A Worcester, England, firm have begun making a single-cycle gas engine. There are but two valves, and no valve gear of any kind, the following is a part of the description given in *Electricity*:

"The igniter being made red hot, the fly-wheel is turned by hand, and with the outward stroke of the piston a charge of gas and air is drawn into the cylinder through a valve in the end, the return stroke compresses the charge, and just before the end of the stroke the gas is ignited through the 'touch hole' in the piston coming opposite the ignition opening or port. The explosion drives the piston through rather more than half its stroke, at which point the exhaust port is reached and uncovered by the piston. This port is

in the upper part of the cylinder, and is fitted with a flap valve, which, after allowing the escape of any pressure remaining in the cylinder, closes automatically, and the piston, continuing its travel, makes a partial vacuum during the remainder of its stroke, and draws in another charge of gas and air. On the return stroke this gas is compressed by the piston as soon as the exhaust port is passed, and ignition takes place, as before described, at the end of every stroke."

A Russian engineer, who visited Chicago last summer, also other places in this country where oil is burned for fuel, says the burners used are not of a good kind, and are such as were employed in Russia more than twenty years ago. The writer, who is an owner of steam furnaces in Moscow, addresses a letter to the *Mechanical World* on this subject, and we are inclined to the opinion that he is about correct in his statements, because having recently looked over a collection of these burners the impression was that they were not as good as those illustrated in foreign journals. Mr. James H. Jones, engineer of the Steamer *San Rafael*, had on exhibition at the Midwinter Fair a patented oil burner that seems to be much superior to other kinds in use here. It injects a mixture of air, oil and steam, and produces a long clear flame without the usual local intensity, and corresponds more to the successful types described by the writer above named.

W. E. Everitt, at Buffalo, N. Y., has invented an implement or apparatus for boring pipe-ways from buildings out under a sidewalk and street to the mains, for connecting water and gas, and has done a thing much needed. It seems useless to dig a great trench, and impede the traffic in streets, to lay a small pipe from a building, especially when pipes are buried deep to avoid frost. There are with each machine fifteen augers or sections that screw together, enabling a range of sixty feet. As we understand the description in a Buffalo daily newspaper, the earth is withdrawn continuously, and one man can easily bore ten feet an hour. The plumbers should give this attention, that is if they desire to save time and labor.

The Sprague Electric Elevator Company, of New York, are introducing a new method of gearing for elevator machinery, consisting of a set of Armstrong sheaves operated by screws driven by electric motors directly attached. The principal novelty over old designs of the kind is in bearings and nuts for the screws being

provided with balls to avoid friction. There are various refinements mechanically, and the designs seem well worked out, but we think that water will hold its place against all such gearing. Ball bearings have no place in machinery when subjected to any but light pressure, and will be apt to give trouble. Mr. Bement, of the Industrial Works, Philadelphia, in 1864, constructed a direct screw elevator for the Continental Hotel, in that City, the nut being composed of a system of rollers mounted on fixed axes. The strain was light, and the endurance good, but the pressure was very light, the "nut" being the whole depth of the cage. The expense was, however, very great, as it must be with the new modification above described. A hydraulic cylinder is good enough for an elevator, and dispenses with counterpoise weights, or ought to do so.

Messrs. Yarrow & Co., of London, having completed the *Hornet* and *Havock* for the Admiralty, and driven them on several occasions at 27.5 knots, or about 32 miles an hour, have now turned about and contracted with the Russian Government to build some boats of the kind to steam 29 knots, or $33\frac{1}{2}$ miles an hour, so the game goes on. These boats are not properly navigating vessels, but water "toboggans." For war purposes, where expense is not considered, there is no limit to speed. By keeping on, the whole vessel can be raised out of the water, to skim over the top, leaving only the screw immersed, and here comes in the idea, why not call it a water train or water-plane? There is no reason why a machine constructed on the principle of an aeroplane cannot disregard buoyancy and skim over the water at any rate that the power for propulsion may determine.

The *Grimm*, one of the Hamburg-American Line of steamers, has been fitted up with external furnaces, or, to be more correct, water-jacket furnaces outside the boilers, and there are claims of a wonderful result, which goes to show more than anything else how little we know of combustion. Not that the design of these furnaces, as shown in published drawings, contains anything new, except in arrangement, because the plan is considered as an experiment. Every result should be predicted, and would be in any other branch of the arts except firing. The Muller boiler and furnace, as the above arrangement is called, is a down draught one in so far as the main air supply, but a portion of the air, enough to protect the bars, is drawn through the grates, the draught being led off at the after end and also at the bottom of the fires.

ELECTRICITY.

NOTES.

Judge Colt, of the United States District Court of Massachusetts, has recently rendered a decision in a suit brought for infringement of Mr. Edison's patent on incandescent lamps that seems to us the most logical one of all. The defendants, a Boston lamp company, employed, instead of the platinum leading-in wires, powdered silver, thinking thereby to evade the Edison patents, but the Judge refused to recognize this subterfuge, and said that Edison's invention lay in the carbon filament, and not in the conductors. Whatever the claims in the Edison patents may be, everyone familiar with the history of the matter, and the long efforts to produce the fine carbon filaments, will conclude the same as Judge Colt has done, that Edison's invention lies mainly or essentially in the attenuated filaments employed in incandescent lamps. The defense of this invention is a history, and one from which can be inferred how difficult it is to protect a valuable invention.

The operations of the General Electric Company are gigantic. The works at Lynn, Mass., (The Thomson-Houston Company) have a floor space of 463,767 square feet, and there are 3,380 people employed. The Edison Company Works at Schenectady, New York, contain 536,000 feet of floor surface, and employ 3,227 hands. At Hanson, New Jersey, where the lamps are made, there is a floor space of 154,000 square feet, and 1,044 hands, making a total for these three works of more than 7,600 workmen, but this is only the center, so to speak, of a system extending all over the country, with branches and property in all of the chief cities. What the effect of such extensive combination may be it is hard to foresee. The main purpose is to avoid competition, but we have yet to see how far the interests of the Company and of the country will be served by such a vast organization.

The Fort Wayne Electric Company last month went into the hands of receivers, and immediately a new company, called the Fort Wayne Electric Corporation, was formed, and the receivers turned the business of the old company over to the new one. In the mean time a claim of \$500,000, due the General Electric Company, was presented, but evaded by the stratagem above noted. The

receivers applied for an injunction restraining the stockholders of the old company from meeting. This circumstance is noted in *Electric Power*, and is worthy of Jay Gould, or the finest of railway games. The circumstances to call out such sharp practice in Fort Wayne must have some explanation not yet forthcoming. One thing seems evident, that the General Company, unless its claims are made good, must come out a great loser in this maneuver.

Mr. Nikola Tesla is all the time bringing light, heat, and electricity into closer communion, or rather is tracing these elements up to a common origin or cause. The different phenomena he claims is due to electrostatic forces, which is not quite clear to other people. The whole scientific world is now waiting for light in this direction, but the ultimate explanation of the phenomena of light, heat, and electricity will come in the way of evolution, not suddenly, but a little at a time as all great truths have been arrived at. Their identity may now be conceded, proved by an array of unmistakable inferences as well as a good many facts. This is now Mr. Tesla's principal field of labor, and his opportunities are many because with the resources of the laboratory he combines the wide field of practical applications.

An electric search light of 94,000,000 candle power, whatever that may mean, has been set up at Sandy Hook, New York. It was made by a German firm in Nuremburg, where a great many curious things, including watches, came from. The light has been erected by the Government on the proving ground, and is said to be visible 100 miles, and will show up a ship twenty miles away. The apparatus was exhibited at Chicago, and is said to be the largest of the kind made to this time.

MINING.

NOTES.

The mines of San Diego County, because a little further away, or more likely because in desert country, most of them, are little heard of in comparison with the northern ones. The Queen, a desert mine in San Diego County, crushes one hundred tons a day. The "Cargo Muchaco" mine manages to perform the feat of a monthly divi-

dend, and the Gold Rock mine crushes one hundred tons a day. There is every probability that prospecting has been much more effective where there is timber and water, and that there will be more discovered and done in future on the arid planes than elsewhere in this State. There is nothing in primitive causes that would distribute gold-bearing quartz with respect to moisture in our time, and the desert offers now the most prominent field of success in finding gold. Its procuration is another matter, but human ingenuity each year gets better control of the water problem, and this seems to be the main thing wanting.

There seems to have grown up recently quite a dry placer-mining interest on the Mohave desert. At one place there is reported a camp of two hundred settlers engaged in winnowing out gold with various kinds of dry apparatus, including fanning mills. The gold is no doubt confined to places where action by wind or water has produced "concentration," but there is a great gain in getting anything out of the waste desert there, especially in these times, and removed from where speculators and booms are likely to reach. The circumstance will start up the dry concentrator inventors again, and it is to be hoped with more success than has attended on their efforts hitherto.

Five hundred men are reported to be working on the Hassayampa River in Arizona, washing and pocket mining; also a large number in the bed of the Colorado River, or rather the bed of the Gila River, where the Colorado is supposed to have run in some former period of time. There is reported there a gold-bearing gravel bed sixty miles long by one to two miles wide, but this sounds too much like the usual canards of gold-bearing districts, which if realized would seriously interfere with agriculture, because the claims would cover the whole country. In Utah there is certainly going on a great number of new enterprises in gold seeking, and the gold fever prevalent there is much needed because of the closing down of the silver mines and allied interests.

There is now, and has been for a month past, a kind of hegira of miners and others up the Yukon River in Alaska, and there will be another less comfortable movement down the river in November. A great deal of gold will be taken out, no doubt, and the number of

people remaining in the country during next winter will be double as many as in any preceeding year, and mining interests there will be more settled for this reason. There is much gold to come out of Alaska. This no one questions, but it will cost all it is worth, as it has in all other places, but this year, with the pressure that is upon people, there is obvious danger in carrying a great number of people too far up the Yukon River. The Government should exercise some vigilance in the late summer months, because an unsuccessful miner will find trouble in making his way out of the frozen region.

The Director of the United States Mint, in a recent report to Congress, says the yield of the gold mines in this country was in 1893, \$35,955,000, and compared with 1892, an increase of \$6,940,000. He farther says, which seems incredible, that the gold yield of the world was one sixth more in 1893 than in any year during the California and Australian eras when at their best. The Director also predicts a larger amount of gold will be procured this year than ever before, so there is no danger of its running out for some time to come at least. We have not compared this statement with any other statistics, but imagine that the increase for '94 will far exceed the difference between '92 and '93, because activity in gold mining is not confined to this country, but is universal.

MISCELLANEOUS NOTES.

Colombia must be a country where carriers prosper, or else the facilities for transportation are bad. Mr. Nichols, writing to the *Engineering and Mining Journal*, from Samaca, says a narrow-gauge locomotive, purchased at Pittsburgh, Pa., for \$3,575, turned up at Samaca with \$10,904 of charges against it. The iron work for four cars costing \$494.48 reached at their destination \$1,610. A turbine wheel worth \$708 cost, when carried within 150 miles of Samaca, \$3,760. Whether it was left there or not Mr. Nichols does not say, but the inference is that the treasury was exhausted by that time. This machinery was for an iron works that has been in course of construction at Samaca for seventeen years past, and if once completed there will be a fine margin of profit there if carrying facilities are not improved. The route is to Barranquilla, up the Magdalena River 660 miles, then by mules 75 miles to Bogota, next by cart road 40 miles, and then by no road 160 miles to Samaca.

The New York *Nation* in a recent issue contains the following truth in respect to an old catch phrase that "trade follows the flag."

"People are deceived by the old British phrase, 'Trade follows the flag,' concocted by Great Britain when she had no rivals, at sea or in manufactures, and could 'lick' anybody who tried to compete with her, but senseless in these days, when every barbarian on the globe is pursued by the rival drummers of half-a-dozen great industrial Powers. Trade in our time follows cheapness and durability. All the navies, steamers, and telegraphs in the world will not make people look at goods unless they are cheaper than other people's."

This statement is perhaps a little too strong, especially as respects savage tribes, if trading is done with such, but it is absolutely true in respect to what we call "civilized markets."

A Minneapolis paper has been footing up the flour-grinding mills in this country and Canada, and places the number at 15,000 for the States and 1,000 in Canada. Pennsylvania leads with 2,200; New York has 1,300, and so on down, but the number of mills does not mean much; nine tenths of them being custom or country mills. For example, in Minneapolis where there are 40,000 barrels of flour ground daily, there are a few mills, but of amazing capacity. The same is true of California, there are not many mills, but they are large ones. Minneapolis is the great center. Here is ground nearly as much wheat as in all other Eastern cities combined. It is a wheat center, and receives a large share of the Manitoba crops which come there over the Winnipeg railway through South Dakota. The great water power afforded by the Falls of St. Anthony is a principal cause of the milling business at that point.

We, some time ago, called attention to the adoption at Chicago of the European method of arranging passenger railway carriages with entrances at the sides, and putting the platforms at the stations instead of on the ends of the cars. The result was that a whole train could be loaded or unloaded in a few seconds, and the convenience was so apparent that the system is to be continued for urban traffic at Chicago. If ever there was anything more common sense than this in railway matters we have missed it. The idea of having passengers both go in and come out of single doors in the ends of a car, then face about and descend several steps, is ridiculous for a crowded traffic, or for any traffic where frequent stops are made.

Hauling about tons of platform that can just as well be a fixed portion of the stations, leaving a space of eight feet between the cars, and passengers to enter and leave by the same doors, and only two for a car, is not good planning and hardly good sense.

The battle between guns and armor plates fluctuates, first one ahead and then the other. At a late trial of 18-inch plates, of the kind intended for armoring the *Indiana*, a 12-inch shot at a velocity of 1,465 feet per second "knocked out" the plate, so to speak, breaking it in three directions. Another shot of the same size raised to a velocity of 1,926 feet per second went through the plate. The shot was destroyed, and the plate also in so far as any future use, being broken in two. This is expensive fun. The plate was 16 feet long, $7\frac{1}{2}$ feet wide and 18 inches thick, consequently contained 180 cubic feet, and weighed 87,300 pounds, and cost from \$15,000 to \$20,000. The shot and powder, with mounting, transportation and expense, would make up, perhaps, \$5,000 more, which, in the present state of the National Treasury, should remind people of the cost of war. Such a view of the matter may appear "provincial," but the fact is deplorable at the same time.

The Philadelphia people are not "slow" over all things. They manage to get at least ten per cent. more for machinery made there than the same work brings when produced elsewhere; also manage to pay their municipal taxes out of ground rents, or assessments on real estate, and then have the cheapest rents in any large city in America; also have managed to house their population comfortably without tenement houses. Now they have constructed, and are successfully operating, a greater length of pneumatic dispatch tubes than any other city in the world. They dispatch 30,000 letters a day, at a speed of thirty miles an hour. The nearly-level site of the city favors such a system, so also the long distances due to the system of building. Every family must have "fifteen feet square open to the heavens." a provision, we believe, of the Penn Charter.

One gets sick and tired of trade names, such as ideal, victor, paragon, excelsior, and the like, also wonders how the makers of machines thus named can afford to waste the effect produced by using the maker's name instead of these pseudonyms. The name of a firm

or company applied to a machine, such as a water-wheel, gas engine or mowing machine, is of real trade value, and comes constantly into use, but a nick-name rarely ever does. Gas engines are thus afflicted, but not steam engines, the latter being accorded too much respectability for a nick-name. We have, out of regard for the machines and believing it to be vastly to the advantage of makers, never printed one of these nick-names in *INDUSTRY* when it could reasonably be avoided.

There is being built at Hanyan, in China, a mammoth iron works, covering 70 acres of ground. The engineer is an Englishman, and most of the plant is being prepared in England. The buildings are of brick, foundations of concrete and stone. There are four blast furnaces, with rolling mills, steam hammers, and all kinds of implements to make ordnance, machinery, locomotives, railway equipment, etc. The cost is estimated at \$4,000,000, and the works will be the largest of the kind in the world. The iron will be mainly from mines in China, and the plant is to be operated by native workmen. U. S. Consul Child, at Hankow, who reports the particulars above given, says there is an abundance of suitable coal in the vicinity, and that these works are the most important ever undertaken in China.

Mr. James H. Smith, U. S. Commercial Agent at Mayence, sends to the State Department a communication on the wealth of Germany that will have some interest here in respect to the amount of invested money. The empire contains about fifty millions of people, and of these four millions, or about one in twelve, draw revenue from investments. The annual increase of wealth has been for some years past three per cent. Stocks, bonds and loans held by the people amount to over seven billions of dollars, of which one half is in foreign securities. From 1860 to 1892 the returns gained on Russian and American securities are estimated at \$238,000,000, but there was also much lost. These statistics disprove what is commonly supposed respecting German finances.

The craze for armaments and "war goods," and the loss of labor by military service in Europe, has had the natural effect of clearing out the national treasuries. England is \$20,000,000 short; the Indian Empire is 15,000,000 rupees short; France is \$5,500,000

behind, and Italy has a deficit of \$10,000,000. Our own country is in a like condition to the extent of \$70,000,000, and among European countries, Russia, the last one thought of, is the first to suggest military retrenchment. No Power in Europe can compare with Russia in her power to control war, that is, on no other country does peace so much depend. Lord Dufferin, of England, in a recent speech at Paris, said :

“I observe that many publicists are of opinion that it is upon the fiat of the Emperor of Russia that the contingency of peace or war mainly depends. If this is the case I think that Europe is in safe hands, for every day is producing fresh evidence of his Imperial Majesty’s wisdom, moderation and peaceful intentions. That he possesses these admirable qualities I have long known.”

Russia alone of all nations is safe from conquest. Her territories cannot be successfully invaded. Napoleon’s march to Moscow and the war in the Crimea show this. Yet it seems now that this power is in advance by wishing to reduce the military power of Europe.

Senator Pepper, of Kansas, in the tariff-tinkering game now going on in the higher chamber, has asked that barbed wire be put on the free list. An improvement on this would be to put it on a black list, and make its manufacture a misdemeanor of high rank. We have experimented a little with this “barbarous” invention, and find that animals that will run through a smooth wire will do the same with a barbed one. Thousands of valuable animals have been killed or rendered useless on this Coast by barbed wire fences, in fact it is hard to find a horse that has been for a time on grazing lands that does not somewhere bear scars of barbed wire. We understand that there are in some parts of the country laws preventing the use of this kind of fences, and that since its removal no change has been noticed in the efficiency of fences between the barbed and smooth wire.

The *Canadian Engineer* in the June number contains some account of dyked lands in Nova Scotia and New Brunswick, that will be news to readers in this country. It seems that around the Bay of Fundy, celebrated for the enormous tides there, the overflow lands have been dyked and reclaimed the same as in Holland, by French settlers that came in 1671 from Rochelle and Pictou.

Nova Scotia and New Brunswick are joined by a low peninsula on which there are thousands of acres of marsh land over which wild deer grazed at the time, and as these settlers came from the reclaimed districts in France they at once settled on these lands, almost the only place on this continent where opportunity of the kind existed. These "Acadian farmers," as the *Engineer* calls them, have 60,000 acres protected by dykes, and have created a Holland in America. The soil, which is ocean and vegetable silt, is forty to fifty feet deep, and is so rich that it is hauled inland for manure.

Seventeen Atlantic cables have been laid, ten of which have been abandoned. They have cost about three millions of dollars each, and have not been especially remunerative. The interest on thirty millions of dollars invested is no small matter, and no wonder the charges for messages are high. The *Railway Review* says, if a land wire breaks one man can be sent to repair the fault, but at sea a ship fully equipped must be sent on the same errand. We have many a time thought that if some one was set at work to figure out the real practical gains of an Atlantic cable the amount would be astonishingly small. Of course no one can see how the thing could be dispensed with now, but we are speaking of real "gains."

An iron company with a million dollars of capital or stock, has been organized at Ogden, Utah, one dollar shares, non-assessable. The purpose is to combine a number of iron interests in the vicinity of Ogden, which are now operated in a desultory manner. There is little encouragement in founding iron works at this time in producing districts, but this does not apply to cases where a local demand exists, and there is a haul of a thousand miles by rail for iron supplies. There are various ores in the mines, about twenty in number, and iron already produced has been of the best quality. Ogden is now, and has for some time past, been a progressive city, and is destined, no doubt, to become the great half-way station of the continent. The production there of structural iron and merchantable bars will be an important matter.

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JOHN RICHARDS, EDITOR.

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THE CHICAGO INTER-LAND CANAL.

This stupendous work, to cost 25 millions of dollars by estimate, and perhaps a good deal more in fact, furnishes a fruitful and interesting topic in various journals that come to hand at this time. The object is to cause a current of water equal to 600,000 cubic feet per minute to flow in a canal 150 feet wide and 14 feet deep, from Lake Michigan to the Mississippi River, through the Desplaines, Kankakee and Illinois rivers. At present the main object is to reverse the celebrated Chicago River and turn its waters with the sewage of the city backward and away from the lake in front of the city, from where the water supply is drawn.

Notwithstanding tunnels four miles long constructed out under the lake, the sewage and water supply get mixed together, and the present expedient has been under consideration for ten years past, not as a new one, but an extension of a system now in use, wherein fresh water from the lake is pumped up to a level that permits a flow backward through the Illinois and Michigan canal to La Salle, one hundred miles away. The present canal is a link, the main one, in a water-way 320 miles long, entering the Mississippi at Grafton. We say the main one, because it is in the 36 miles to Joliet where the most of the money must be spent in excavating, also in providing locks, when navigation is attempted, to overcome a fall of 140

feet. A depth of 14 feet has been determined upon, and there is little doubt that at some time not far distant, steamboats will run from Mississippi ports to Chicago, that is, if the railways will permit such an infraction of their interests.

A water-way here is not a new thing; there is conjecture and evidence that at some former time, a few thousands of years ago, that the North American Lakes were at a higher level than now, and those above Huron discharged their waters that now flow over Niagara, through this outlet to the Mississippi. There is, it is claimed, a clearly defined channel, showing evident water marks, and large enough to accommodate half a dozen such rivers as the Niagara or St. Lawrence. This indicated channel is two to three miles wide, and 150 feet deep where it is carved through the rock formation, but is a matter of little concern to us now, except to furnish a subject of speculation for scientific folk.

In modern times, and within the brief history of our country, since the French occupation of the Northwest, this proposed water-way is not without a history, one of much interest now when the problem is being attacked in so vigorous and extensive a manner.

The situation of Chicago in respect to such a drain-way is fortunate. The Desplaines River was the outlet southward of a small lake or pond, within the recollection, and almost within the present limits of Chicago, but now dried up. The now odorous and odious Chicago River drained half this pond to Lake Michigan, and the Desplaines, Kankakee and Illinois rivers drained the other half to the Mississippi.

When this was discovered, more than two hundred years ago. The French explorers saw the possibility of a canal to connect the Lakes and the Mississippi River, and the subject has never been dropped since that time, has been kept constantly in mind by the fact that the Desplaines River at its high floods sometimes sent a portion of its waters to the eastward, down the Chicago River to the lake, and for at least one hundred years past a canal project has been continually before people interested in the matter.

In 1804 Congress had a turn at it, and reports were made by engineers, but the work was too great to be undertaken with the resources of the Government at that time, but in 1836 the State of Illinois undertook the work and spent five millions of dollars upon it, without having first ascertained the fact that the cutting would have to be through solid rock for a distance of twenty miles or more. The canal level was then raised and the work extended to La Salle, on the Illinois River, a distance of 100 miles.

In 1871 the highest portion, near Chicago, was cut down to the level of Lake Michigan, so as to cause an outward flow, but not enough to meet the requirements of drainage for that city. The conveyance of sewage, it must be remembered, is not the only point to be considered in such cases. It is not even the main thing. Dilution must be provided for, otherwise an open canal would cause a pestilence throughout its course, and this we fear is to be a result of the great outfall for the City of Mexico, there being a lack of water to cause dilution down to a safe point.

The flow through the canal was so sluggish that the water or sewage became unendurable in 1884, and pumps were erected to raise 60,000 cubic feet per minute from the Chicago River into the canal. This caused a back-flow in the river, as should have been foreseen, and the scheme failed of its object, so did the pumps, in so far as efficiency, a matter we mention because of centrifugal pumping being at this time a subject treated upon in this Journal, and this circumstance illustrating some facts of history elsewhere set forth. Here was a great city, supposedly in command of the highest engineering skill that the time afforded, purchasing and erecting centrifugal pumps of a type that could not in any reasonable way attain more than two thirds of possible efficiency, or of what has been attained in hundreds of cases. Perhaps, however, it was only an experiment, and expected to fail.

In 1886 a special commission was appointed by the city of Chicago to consider the subject of sewage and water supply. The conclusion was, after full consideration, that the sewage should be sent over the old route, diluted with pure water, to a point where the canal would not be offensive to people on the course of the stream. This is the work now in rapid progress. From Chicago to Joliet, 36 miles; as large as the Manchester canal, or near it, being made with all modern expedients known to the art.

From Joliet it is expected that the General Government will open the channel to the Mississippi River. This will be an easy matter, because the volume of water from the Chicago canal will substitute the present slack-water system by means of dams and locks in the Illinois River. If this is done, the city of Chicago promises to turn over its interest in this great canal from the lake to Joliet, and thus create a free water-way from the Gulf of Mexico to Chicago.

Twenty-six out of thirty-six miles of the canal are under contract. Ten million cubic yards of solid stone, and twenty-five

million yards of "glacial drift" are to be removed, and for this \$16,000,000 is provided. Ten thousand men will be set at work, a fortunate matter in these times.

For three months each winter the canal may be closed with ice, but this does not matter, inasmuch as the lake traffic is closed at the same time. The chief engineer says that since 1887 the canal would have been open all winter, except in two seasons, but just how he knows this is not clear.

The management is in the hands of nine elected trustees, who are paid salaries of \$3000 a year, and there will not be any "Credit Mobilier," or "Contract and Finance" schemes. Not that the moral atmosphere of Chicago will prevent, but the people will not stand being swindled. It would be a reflection on their astute qualities, so much vaunted and generally admitted.

What the future may be of this great work is of course shrouded in some obscurity, but as it is being done with money to be returned in taxes assessed over a district of 185 square miles, under an Act of Legislature, and all the money borrowed, there is no financial reason except false or mistaken estimates to interfere. There is, however, one problem of importance unsettled yet, of how to accommodate traffic or secure terminal facilities at the lake on ground that is so valuable as to preclude its condemnation. The canal begins three miles from the lake front, and the Chicago River cannot without widening or deepening furnish the volume of water provided for and necessary in the main canal. To deepen the river would destroy the level or grade, and to widen it is impossible, so that some other intake will have to be provided for.

Chicago is not alone in this problem of dumping sewage and drawing a water supply from the same source, but it has sooner arrived at the point of culmination, also is perhaps the worst situated of lake cities, being on the apex of a bight or bay. Detroit, Montreal, and Quebec have constant currents that produce ideal conditions. Cleveland, next to Chicago, begins to feel the press of penned-in offal. Toledo and Toronto will follow with some means of keeping their sewage out of the lake.

THE SIBERIAN RAILWAY.

Last year, and at various other times, we have published articles and notes respecting the great Russian railway now being built from Siberia to Vladivostok, on this side of Asia and opposite our

Alaskan Coast. This railway begins at Moscow, and extends 9,500 miles through a country where the physical difficulties to be overcome would be appalling to any other than the Russian Government.

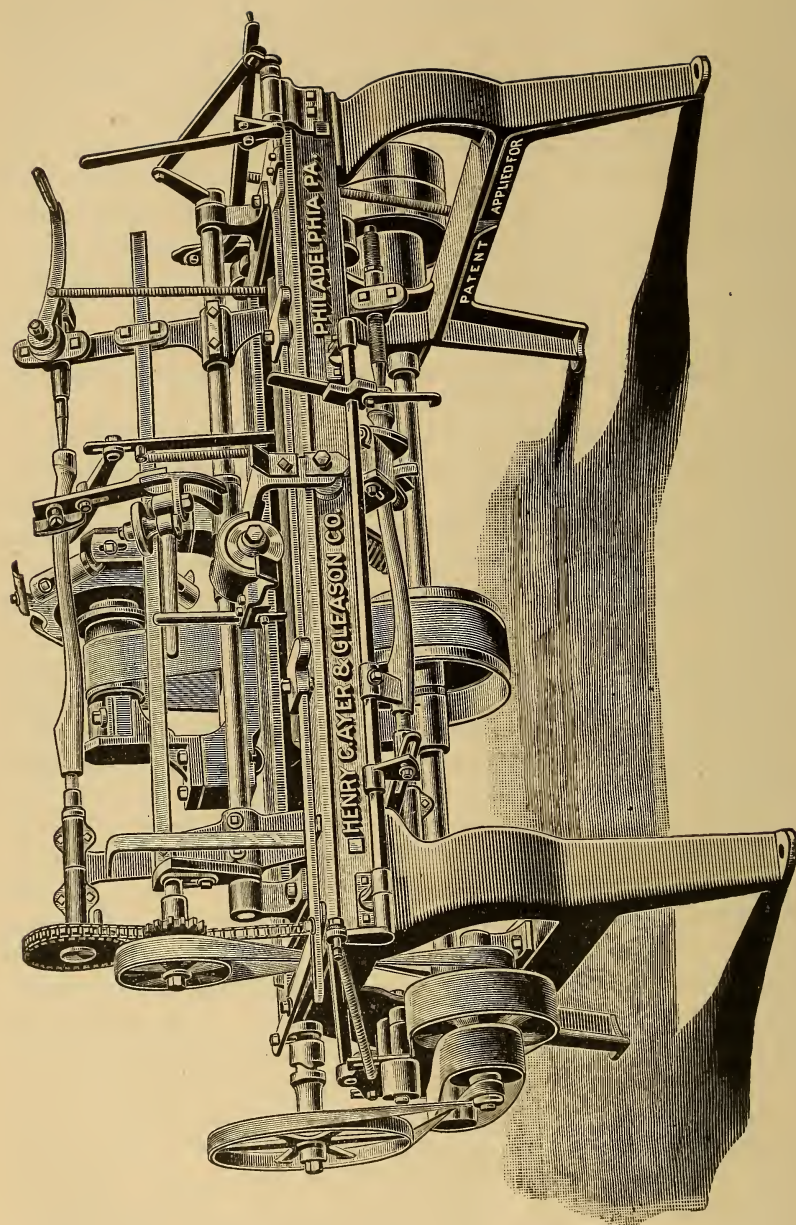
The Russian Empire covers one sixth of the earth's land surface, peopled by diverse nationalities, and even by different races of men, that the administrative powers of no other country could deal with for a month even. There is a free constitution in Finland, and autocracy on the Tartar borders, with all shades of government between; a vast complicated system adapted to all kinds of humanity and all kinds of circumstances, hard to be understood and impossible to imitate; the dread of the "shrieker for freedom" and the man of license who wants liberty to purloin from his neighbor. The Russian system is adapted to the requirements, as is government in most of the older countries.

Siberia is to Russia what the United States west of the Alleghany Mountains is to the eastern section of the country, only more removed, and as our borders were fifty years ago. Emigrants require years to reach even the middle country, and five, or even ten years, to reach the Amoor River country by the tedious methods there available, only a few months in summer being suitable for travel.

The opening of Siberia will be an event in the world's history like the discovery of the American continent. The resources are of course not well known, but in minerals can be conjectured. The area is nearly five millions of square miles, covering twenty-five degrees of longitude and one hundred and twenty degrees of latitude, but having now only four millions of inhabitants.

The gold now produced there and in the Ural Mountains amounts to 30,000,000 roubles, or \$24,000,000. Iron, coal and salt are found widely. Timber, precious stones, and indeed products of all kinds are embraced in this immense territory, but the Siberian railway, if it be constituted a commercial one, which is sure to be the result in the end, will become the route for the tea and silks of China and the products of Japan, which can be carried to Europe in a fifth of the time now required by sea.

The part this country may have in this great enterprise must depend upon what our connections are to the Behring Sea, and it must be admitted present indications are not promising. The Canadian Pacific Railway, in so far as promoted and owned in England, is undoubtably a link in a new route to Asia, and is even now such a route in so far as China, Japan and Australasia, but the connec-



MACHINE FOR TURNING IRREGULAR FORMS.—HENRY C. AYER & GLEASON CO., PHILADELPHIA, PA.

tion to Behring Straits was also in view as evidenced by surveys now made and making in that direction by, or in the interest of, the Canadian line.

Our present connection with the Siberian coast consists of one or two vessels dispatched annually to the Amoor River. It was a Boston enterprise to begin with, and a creditable enterprise, but in case of the great railway line to Vladisvostok being opened we should reasonably expect some result in San Francisco that will mark a new era in the City's commercial history.

MACHINE FOR TURNING IRREGULAR FORMS.

HENRY C. AYER & GLEASON CO., PHILADELPHIA, PA.

The machine shown opposite, which is sometimes called a duplicating one, or spoke and handle lathe, is, in its various types, one of the most remarkable ever invented in this country, and one that has had a great deal to do in developing woodworking industry of various kinds.

The principle product, as one of the names above given implies, is spokes and handles, and these alone are an enormous item, but there are many other things shaped in this way. We remember once happening in a shop where hobby horses were being turned out of blocks of tulip wood on one of these machines. Shoe lasts are turned on machines but little modified from the above, the main difference being that the lasts are quite expensive in comparison with spokes and handles, consequently can be turned slower and smoother.

Before speaking of the particular machine shown in the drawing, and one that has the first important change made for thirty years past, we will treat this subject of turning or "machining" irregular forms in a general way. It is one that has always been of popular interest, because the common ideas of machine action are associated with regular forms, bounded by right lines or true curves, square or round, and this does comprehend the greater part that is done on machines, still, as before said, irregular forms hold a prominent place. The original conception of working from models, or duplicating with cutters guided by a model, on the principle of a pantograph, was invented in France. Under what circumstances, and by whom, we cannot say, but of the fact there is no doubt, as will appear farther on.

The first application of which we have any account in our own language dates from the beginning of the century, and with the

most noted engineer and mechanic of that time, James Watt, who about the year 1812 began the construction of machines of this kind, or for duplicating. It was after he and Boulton had brought the steam engine up to its successful form, and the revenue from sales and royalties was sufficient to relieve Watt in a measure from his labors at the Soho Works.

Watt's home was at Heathfield, about two miles from Soho, where he had nineteen acres of ground, a native forest, and near the center a quaint rambling old English house, yet standing, but extended by its present owner in 1886. In one wing he set up a workshop over the kitchen, where he spent a great share of his time from the date above given down to 1819, when he died. The old house is now leased and occupied by George Tangye, Esq., managing partner in the Great Cornwall Iron Works of Tangye Bros., near Soho, and near the old Boulton & Watt Works, now represented by James Watt & Co.

The most prominent thing to be seen in this old workshop of Watt's, which we examined some years ago, were these duplicating machines. On one of them was a medallion half finished, and just as James Watt left it in 1819. Nothing has been disturbed since then, even the embers in the stove lie as left seventy-four years ago, while nearly central in the floor stands the copying machine. It is a pantograph carving machine, if we give it a technical name, but it has all the elements of this class of machines, and is even a most advanced type. Our readers will wonder why Watt did not give this matter more publicity, or secure patents on his invention. There are two reasons. He learned before his death that his invention had been anticipated in France, and he died before he had completed his machines for carrying the scheme into practical effect. This is the beginning of the art in England, but it did not pass into public use.

In this country the first machines of the kind were invented in 1820 by Boyd or Blanchard, and, as we believe, with the object of turning or shaping musket stocks for the United States Armory at Springfield, Mass. This invention, which was a thoroughly practical one, was made quite independent of the pantograph methods in England or in France, and with the difference that the movements required to follow the form were given to the pieces to be shaped or cut, and the cutters were stationary or mounted on fixed spindles parallel to the axis of the work and the model. This, while it would not produce all kinds of irregular forms, met the

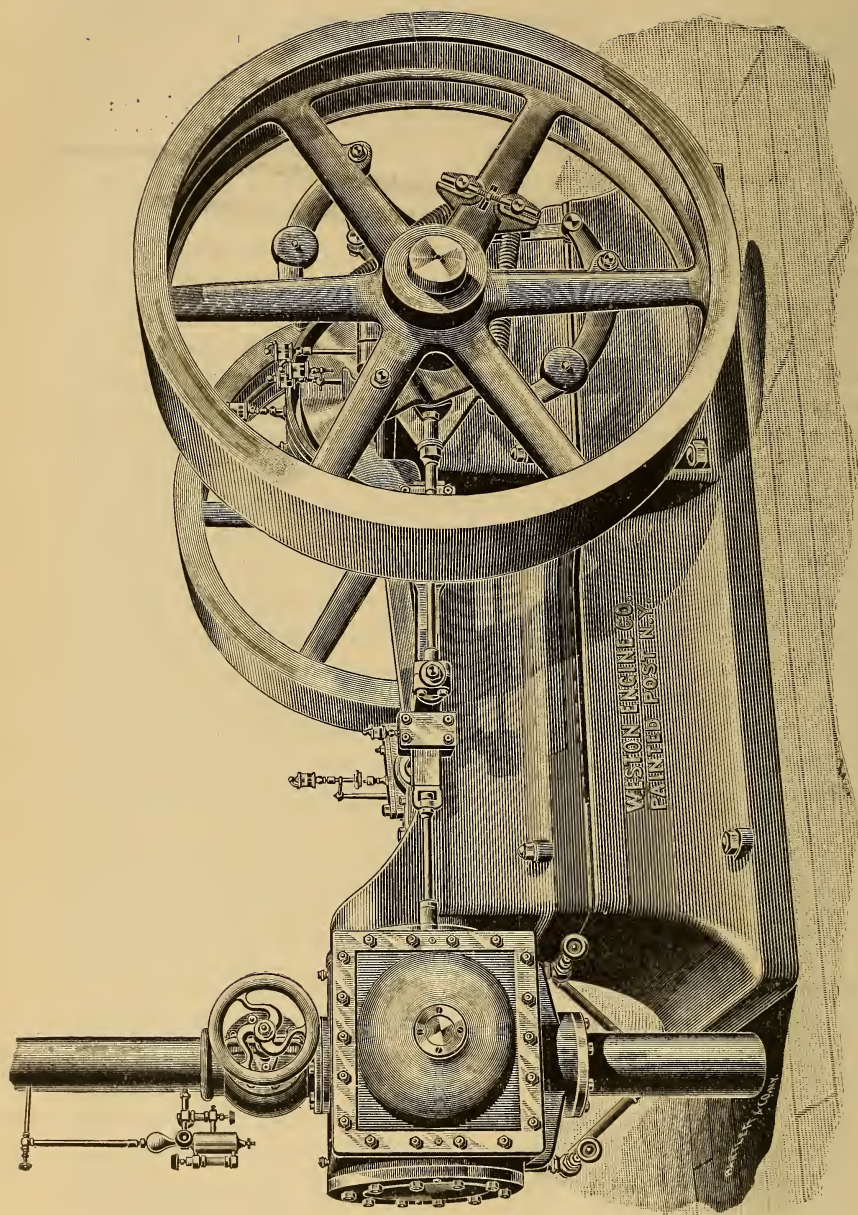
principal requirements in various manufactures, and permitted the use of large cutters mounted on heads of large diameter, as seen in the drawing.

The amount of cutting done by any wood-cutting implement is commonly as the length of the cutting edges multiplied into their velocity. In the Blanchard type, or in the machine in the drawing, six or more cutters can be used aggregating a length or width of edge up to two feet, or more if required, while in the pantograph type one inch of cutting edge would be a maximum, hence a machine like the one shown will turn out from 750 to 1,000 carriage spokes, or a corresponding number of other forms, in a day.

Referring now to the drawing, Mr. Gleason, the inventor, has been for more than thirty years continuously engaged in making such machines, and until recently mounted the model and the piece to be turned at the top of the machine, at different distances from the radial center of the swing frame, this latter being pivoted on or at the driving shaft beneath the machine. This called for a variation between the model and the finished work as their relative distances from the fulcrum of the swing frame, but in the present machine the work is put at the top, and the frame is pivoted at the center, the model being placed below at the same distance from the center, so an exact duplicate is produced. In machines as hitherto made the limitation of capacity has been the speed at which the model and piece could revolve, or the rapidity of vibration the swing frame was capable of, and as these were as the weight and radial length of the frame the effect of pivoting this frame in the center instead of at its end will readily be perceived.

The most remarkable feature of this and other types of the Blanchard machines are the "following rests," seen bearing against the piece opposite the cutters at the top. Without this rest, which resists the blows of the cutters and prevents vibration, no small pieces, such as carriage spokes, could be turned. This back rest is like the swing frame operated by the model by links and levers that can be traced out in the drawing. The upper and lower spindles, and centers on which the model and work are mounted, are positively connected by a pitch chain, seen on the left, so the two will revolve coincidentally.

These remarks necessarily presuppose some acquaintance with such machines on the part of the reader. It would otherwise be impossible to convey an idea of all the various parts and functions of such a complicated machine.



HIGH-SPEED AUTOMATIC STEAM ENGINE.—THE WESTON ENGINE CO., NEW YORK.

HIGH-SPEED AUTOMATIC STEAM ENGINE

THE WESTON ENGINE CO., PAINTED POST, N. Y.



The automatic type of steam engines regulated by variable range or cut-off in the steam-distributing valves has met with universal favor in this country for several reasons. Among these, it was an extension in a more simple form of expansive regulation introduced in the famous Corliss type of engines, also because the exigencies of high speed opened a congenial field for American engineers.

High speed has been a constant characteristic of machinery of most kinds in this country, now introduced, it is true, in various European countries, not only, or indeed so much, in steam engines as in other kinds of machinery, especially what may be called converting implements for iron and wood. In working wood, for example, and speaking of twenty-five years ago, mortising machines were driven in Europe at from 60 to 80 revolutions per minute, and in this country 250 to 400 strokes. Moulding machines had there a lineal feed of 15 to 25 feet per minute, and here 40 to 60 feet. Rotary spindles of all kinds for woodworking were driven at very nearly double the speed common in Europe. The same remark applies to metal-cutting processes. The American idea seemed to be a high rate of movement and slow feed, rendered necessary, perhaps, by a lighter construction of machine tools at that time, lighter sections for the parts or pieces operated upon.

There were exceptions, it is true. The speed of railway trains for one thing, also the speed of reciprocating saws, and in some other cases where mass enabled a more rapid rate of reciprocation or revolution, but an average of all American practice tended distinctly to high speed, and there is little wonder that when the weight and, to some extent, the first cost of steam engines was discovered to be inversely as the speed of revolution; that element became a matter of evolution, reaching limits that had never been thought of before, but it was soon found that both weight and cost had to be in proportion to horse power, or should be so, except as to fly wheels.

High speed demands permanently connected motion rods and valve gear, and, as before remarked, when the variable cut-off function was found possible without detachable gearing the "art" sprung ahead at a wonderful pace, and has not only supplied an almost indispensable element in generating electric currents, but it has done more to improve constructive features than any other

change of our time, or of any time. No sham work was admissable, no material but the best could be employed, and no cutting down of proportions without commercial risk that could not be assumed.

Under these conditions and requirements the makers of high-speed engines have, in most cases, engraved to scale the main parts of their engines, showing definitely the proportions and manner of construction. It is wonderful, and affords the best example of what is technically called "working out" that can be referred to in modern machine practice.

These thoughts come to mind while turning over a catalogue of the Weston Engine Company, recently received, and by noting, as a mechanic, the provisions for compensating strain and wear. We have not space to reproduce examples of the parts, but publish at the head of this article a drawing of a Weston engine of the most simple form as it appears when erected. In examining the sectional views, one familiar with old-time practice gets the impression that all the parts and elements of the engine have been doubled, except the bore of the cylinder, which remains the same. Indeed this estimate is not far wrong..

Turning to tables of dimensions we find the speed of revolution recommended to be from 500 to 600 feet per minute, or about twice the old standard, and the weight of the engines arranged as shown in the drawing reach 1,700 pounds for each inch of bore for engines of 150 horse power, and 1,000 pounds for engines of 60 horse power, which is at least double what was thought necessary only a few years ago. There are many new features and suggestions in the practice shown by the catalogue named, and the engines are worthy of careful study, as an advanced type in the class to which they belong.

A NEW THEORY OF WAGES.

The *Nation* has in a recent issue ventured into a discussion of the labor problem, or wages problem, and fired a volley at their old enemy, Henry George; have discovered that wages are paid out of "accumulated" capital, which brings to mind the old discussion of "what is capital?" Volumes were written in arguing this matter, which was set at rest forever by Henry George, when he said: "capital is what is written in the capital account." Here was a solution in nine words, logical and final, lying beneath the nose of every manufacturer or business man in the world, who has only to

look at his ledger and see what is written in the capital account. There was the thing itself, proved and incontestable.

We recommend the editor of the *Nation* to walk around to the nearest business house or manufactory, any one will do, the first one he comes to, and see if he can find any wages in the capital account of the firm or company. This is the practical common-sense way of determining the matter, "the thing itself." He will find that capital account is debited with merchandise, which the merchant buys, and the manufacturer partly buys and partly makes, and that the wages involved is treated the same as the money paid for completed goods, and it makes no difference whether the firm or company made the goods or some one else made them. If the merchandise and sales credits do not balance the capital account, there is a loss. If they exceed, there is a gain. On this basis balances are drawn.

Wages are an element in the merchandise bought, and in no way effecting capital unless they fail to produce themselves and go to a profit and loss account. In that way they become a real charge against capital to the extent of the loss. The *Nation* takes a simple business proposition and drags it through a slough of sophistical rhetoric that has nothing to do with real business and its economic elements. Reading this in the *Nation* at the end of thirty years is not reassuring. In the same article are the following words in respect to the claims of the Pullman workmen :

"The ethical theory thus crumbles away when it is put to the test of experience. It would require that the Pullman Company should now work for nothing, for that would be about their share of the profits of the concern."

The editor of the *Nation* knows very well that there was no such assumption on the part of the men. There is no doubt a good many of them know a good deal more of the nature and relations of wages, not to mention the business of the Pullman Company, than the writer of the article we are commenting on. Skilled workmen in America are not the fools here implied, and it is much more likely that their belief was that the statement of profits was not true, and even if true it was produced by the jugglery of a capital account inflated five times or more, and that dividends at a rate of forty to fifty per cent. on the real investment had just been paid.

Just what the conclusions of these men were is the main point of all. If wrong, it only requires correct reasoning and explanation to convince them of error. The *Nation's* contribution on the subject does not do this.

STEAM TURBINES.

Dr. C. G. P. de Laval, of Stockholm, Sweden, the inventor of the steam turbine or impulse engine that bears his name, now known all over the scientific world, has proceeded to secure patents in this country on his steam turbines, and we may look before long for the appearance of this new motor.

Dr. Laval is the inventor of the centrifugal cream separator, and, as we have been informed, was first led to the study of steam impulse wheels by supplying such a means of driving his cream machines, which run at a speed greater than can be attained in a satisfactory manner by common gearing. In this respect the steam wheel filled all requirements, in fact exceeded them, because the periphery of the wheels when moving at one half the velocity of the impinging jet of steam will reach about 400 feet per second or 24,000 feet per minute.

Dr. Laval has not been alone in this matter. The Hon. C. A. Parsons, in England, was early in the field, and, as many of our readers know, had in 1888 reduced his steam turbines to a practical and commercial form for driving dynamos. These engines were illustrated and described in No. 5 of this Journal, December 1888. Since then they have steadily made way, until within the last year when large electric stations in London and elsewhere have been fitted up with Parsons' engines for permanent duty.

We may also mention the Dow engine, one of the same class, but of different arrangement, invented in this country, also other forms, but the original engines are those of Dr. Laval and the Hon. C. A. Parsons.

In these engines the general methods are alike in so far as consisting of wheels provided with vanes almost the same as a Girard or Pelton water wheel, the steam being applied by a jet in the same manner, indeed Pelton wheels have been experimented with here impelled by a jet of steam, and, as we have been informed, with fairly good results in so far as steam consumption.

There is, however, a wide difference in the manner of applying the steam on the Laval and Parsons' wheels. In the case of Parsons' the steam escaped from the nozzles at boiler pressure, and then, as in a compound engine, went on from one set of vanes or buckets to another, increasing in size corresponding to volume of the steam, the course being reversed at each application. To carry out this

method Mr. Parsons employed at first nine separate wheels, but in his later engines has much simplified them, reduced the number of wheels, and enlarged them so as to reduce the speed of revolution, which was at first from 10,000 to 15,000 per minute.

Dr. Laval, on the contrary, expands the steam down to atmospheric pressure before it comes in contact with the wheel, consequently requires but one wheel and one set of buckets. The theory is, and it is fully borne out by results that the velocity of the steam not only continues after it has been expanded, but is increased by the added volume, as will be farther explained in future. The effect produced is therefore greater than if impingement took place at the initial pressure. This is done by simply enlarging the nozzles just before the steam escapes. The action is in some respects like the injector that depends upon the velocity of the steam continuing after it is condensed or turned to water.

The effect of Dr. Laval's system is to greatly simplify and cheapen the engines by avoiding the close-running joints required in the Parsons and Dow wheels, and also expensive provision for expansion, or compounding, as it may be called.

It is a curious fact that the velocity of steam in flowing through pipes, or from orifices, seems to be a function of temperature instead of pressure, the common formula being :

$$V = 60 \sqrt{T + 460}$$

This produces a nearly constant velocity at all pressures, such as are commonly employed for steam engines, as follows :

Pressure in Pounds per Inch.....	25	30	45	60	75	100	150
Velocity in Feet per Second.....	863	867	877	885	891	898	908

From this it will be seen that suddenly increasing the volume and lowering the pressure does not much affect the velocity, which is the element depended upon for power. It will also be seen that high velocity must always be a feature of steam motors driven by the impulsive force of steam, and that the maintenance of bearings calls for a high grade of workmanship and careful lubrication, but as the engines are now made does not surpass the resources of modern machine fitting of the best class.

These remarks are written without referring to particular facts, which have been regularly noted in this Journal for six years past, but in a general way, it may be claimed that steam turbine wheels

have now attained an efficiency in excess of average steam engines in use, and about equal to the compound non-condensing kind. The weight per horse power may be inferred from the high velocity, and should not exceed one-tenth that of piston engines of like power.

The art, to so call it, of impulse engines is progressing quite fast enough. "Meteoric" inventions that "revolutionize the world" in a few months are apt to drop out of sight with the same celerity, but the time has now come when steam engineers should seriously consider the subject of impulse motors.

One of the most remarkable circumstances connected with the evolution of impulse engines was the computations of Mr. Parsons, which go to show the value of scientific treatment when the premises are correct. Before he started his first engines he prepared formula showing the work that could be obtained from a given quantity of heat or steam, and experiment confirmed almost exactly what he had predicted, so it was with his improvements. The engines, as we now remember, consumed at first about forty pounds of steam per horse power, and then by degrees gained on this until the present modifications consume about twenty pounds, or one half as much as at first. There are also other gains, such as a reduction in rotative speed or number of revolutions.

We received from Dr. Laval, four years ago, a pamphlet relating to his motors, printed in the Swedish language, and by comparing find that no change of importance has been made, and that recently published drawings show substantially the same construction.

We are of the opinion that of the two or three systems the Laval one will prevail, and attention should be directed to his engine in this country. There is also an apparent difference in respect to construction, the Parsons engine being much more completely carried out in a constructive way, and leaving no margin for improvement. On the contrary we very much doubt if the Laval engine will remain in its present form, or that it would not have been much better constructed in England, or this country, where ultimate design in steam machinery is more rapidly reached than in most other countries.

On this Coast, where steam engines are applied to uses more diversified than any where else in the world, and where, in a larger number of cases than elsewhere the avoidance of weight is an object, the steam turbine, if it succeed, will have a foremost place. In agriculture, prospecting, irrigating, and so on, portable engines are extensively employed, and the market is much wider than is commonly supposed.

Continued from page 484.

CENTRIFUGAL PUMPS.

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It is a commonly-entertained opinion in this country that centrifugal pumps were invented and first applied in Europe, and the art, to so call it, is one in which American engineers and mechanics had but little part down to recent years. This opinion being inferentially at least, promulgated by some recent articles on the subject (1886) has prompted the writer to carry out a long-intended purpose of giving some history of this important manufacture, and establish, as far as ascertainable facts will serve, the part that has been contributed from the United States.

It will, no doubt, be a matter of surprise to most of our readers to know that centrifugal pumps as practical operative machines are strictly and entirely an *American Invention*, and that twenty years before such pumps were made or known in Europe they had in this country attained a form and efficiency but little inferior to the best practice of the present day, and in some respects superior to pumps that are now made and sold. This matter will, in a future place, be explained, and drawings given of American centrifugal pumps made between 1818 and 1830, long before any such manufacture was thought of in England, or on the Continent of Europe.

THE MASSACHUSETTS PUMP.

A pump embodying almost every essential feature of modern practice was invented in Massachusetts in 1818, thirty years before the same thing was applied in Europe, and forty years before there was a modification there that can be called an improvement.

The drawing (Fig. 13) is a section through what was called the Massachusetts pump of 1818. It, as can be seen at a glance, is the "parent of its tribe," the completed machine, and in useful effect would equal, if not excel, either of the modifications exhibited at London in 1851, thirty-three years later. It is proposed, however, in the present chapter to deal with the chronological part of the subject, and discuss separately the merits and constructive features of the different pumps.

NOTE.—It is to be regretted that notes of the various references consulted by the Author in 1886 have been mislaid or destroyed, otherwise citations would have been given here. The search, mainly in serial literature of the time, was too long to be repeated.

The Massachusetts pump fell on barren ground. There was at the time but little use in the United States for such pumps, and but scant means of communicating inventions over the country. There was land enough without draining it, and water raising except from wells was exceptionally required. We, however, hear of the Massachusetts pump finding its way to New York in 1830, and being exhibited there with very satisfactory working results, guessed at then no doubt, but ascertainable even now if it were worth the trouble.

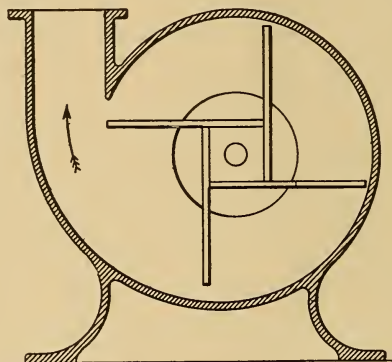


FIG. 13. THE MASSACHUSETTS PUMP.

The casing was of rectangular section, beveled from the center to the periphery, but not in a degree to conform to volume and velocity, as a theoretical pump of our day would be, but an approximation that showed the inventor had an inception of the true working conditions.

The first pumps were made to operate under water, like those of Bessemer, and I conjecture the improvements mentioned in connection with the exhibition at New York, in 1830, to be the addition of side suction pipes, because the pumps were exhibited in public, which could not well have been done if they were submerged.

GWYNNE'S CENTRIFUGAL PUMPS.

The Gwynne pumps, referred to in the writings before named, are of American origin. They were at first an attempted and doubtful improvement on American methods well known and successfully

applied at the time ; not only this, the first experiments of Mr. J. S. Gwynne, the senior brother among those of the name now comprising the firm of Gwynne & Co., and J. and H. Gwynne, of London, England, were made in Pittsburg, Pa., in 1844. The first pump made by Mr. Gwynne was for the Passaic copper mine, in New Jersey, the location of which I am unable to ascertain at this time.

Mr. Gwynne's first patent was taken out in the United States, from New York, where he then resided, and where he continued to reside for some years after the great contest and controversy with Appold at the London Exhibition of 1851, when such pumps were for the first time publicly exhibited in Europe.

The pumps shown there by Mr. Gwynne were called "Gwynne's American Pumps," and it was, no doubt, in some measure, due to this fact that the controversy arose between he, Easton & Amos, now Easton & Anderson, who exhibited the Appold pumps, also with the makers of what is called the Bessemer pump, as will be hereafter explained.

I think the term "Gwynne's American Pump" was hardly correct, because Mr. Gwynne's alleged improvements on the American pumps, as before intimated, were of questionable value, as he would no doubt now admit, at least they form no part of his present practice, and, as a matter that need not be one of opinion wholly, I will venture to claim that had the centrifugal pumps as made in America previous to Mr. Gwynne's improvements been put in competition at the exhibition of 1851 they would have given much better results than either of the three that were exhibited there.

The drawings to be given hereafter will prove this, because in the light of modern experience, the duty of a pump of this kind can be very fairly ascertained from its construction.

The experience of Mr. Gwynne in the United States, during a term of ten years or more, was, in a sense, the foundation of the manufacture that bears his and his brother's names. This manufacture, which is one of the greatest facts in the recent history of centrifugal pumps, was but a continuance of the art transplanted from America, and for a long time without substantial improvement except in workmanship and strength. It will not be too much to claim that after various experiments and modifications the practice *settled down to very nearly what it was in this country in 1830*. It went through a cycle of change and experiment, which, as will be shown in a future place, was alike unusual and not flattering to engineering skill of forty years ago, not to be wondered at in this

case, however, because the construction of these pumps has even now scarcely settled down into a regular engineering manufacture.

The comparatively limited use for pumps of the kind in the United States, where no lands were drained, where water-raising was seldom performed under circumstances requiring centrifugal pumps, permitted this manufacture to lag behind. It also fell into the hands of firms without engineering skill, or without the skill and opportunities required to develop it as the firms of Gwynne & Co., and John and Henry Gwynne, have done in England since 1855.

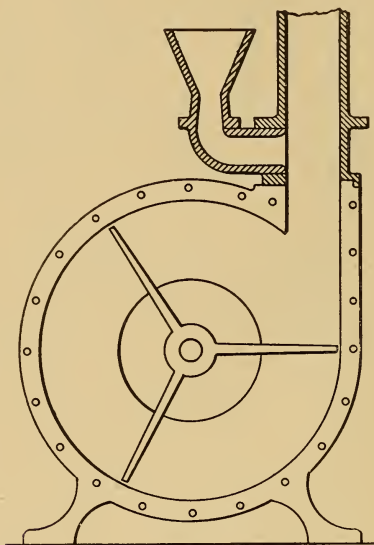


FIG. 14. EARLY GWYNNE PUMP.

The works of Gwynne & Co. were situated at the water side, just south of the Temple in London. The ground on which these works stood was acquired by the Commissioners for the Victoria Embankment, and the works were moved back to a position almost opposite the Temple Station of the Metropolitan and District Railway.

The works of John and Henry Gwynne are at Hammersmith, eight or ten miles westward on the Thames, and among the engineering manufactures of England it is to be questioned whether, on the grounds of careful workmanship, the selection of material or general good quality, there is any branch more carefully conducted.

The pumps, as before claimed, have gone through a maze of modification both in England and on the Continent. There has been retrogression as well as advance, and, except in the case of Messrs. Gwynne and some other firms that follow them, there is not much beyond the American practice of fifty years ago.

Mr. Gwynne, in his patent of 1851 in the United States, begins his claims by saying, "I do not claim to be the inventor of centrifugal pumps," and after other negation to qualify his discoveries, confines his positive claims to certain mechanical details, which, as before remarked, have long ago disappeared in his own practice, and, so far as I know, never had place in any machines except those made soon after 1850. The pump for the Passaic copper mine was, we may infer, in its main features, similar in construction to those exhibited in London in 1851.

This latter was an encased impeller pump with arrangement to protect the back of the disc from pressure, there being a single inlet at one side. It was carefully engraved at the time, and can be examined in the patent and other references now available. It was called "Gwynne's Direct-Acting, Balanced-Pressure Centrifugal Pump," and called also, as before mentioned, "Gwynne's American Pump." It is shown in Fig. 14.

BESSEMER CENTRIFUGAL PUMP.

Messrs. Gwynne, Appold, and Bessemer were exhibitors of rival pumps at the exhibition of 1851, and out of a controversy that arose there we are indebted for some history of American pumps that would otherwise no doubt be lost. Our meager records of that time, and a period of no record of inventions to speak of, from 1818 to 1847, has left us without history of early practice in this country, but in order to combat some of the claims made by Mr. Bessemer (now Sir Henry) Mr. Gwynne and his friends were obliged to bring forward accounts and descriptions of the American pumps that formed the basis of Mr. Gwynne's practice. This, however unwillingly it were done, was unavoidable, because Mr. Bessemer had attached to his pump at the exhibition a placard bearing the following inscription:

"This model of a centrifugal pump for forcing fluids is made in rigid accordance with the specification of Mr. Bessemer's patent, dated December 5, 1845, being the first recorded invention for impelling fluids by centrifugal force by a revolving disc."

This pretentious claim will appear a little ridiculous in the light of the facts, unless the word "recorded" is employed as a qualification; at any rate it gave offense to Messrs. Gwynne and Appold, and, as before remarked, caused a controversy between the commissioners and jurors of the exhibition as well as exhibitors.

No doubt Mr. Bessemer had made an original invention so far as he was concerned, and discovered the employment of centrifugal force for "impelling fluids." He was, in fact, engaged in making centrifugal drying machines for sugar, and, no doubt, at the time had more to do with centrifugal apparatus as an element in machine construction than any engineer then living. His pumps as then made, subsequently improved and patented again in 1849, bear, in many respects, close analogy to centrifugal drying machines. One idea was born of the other, or, as might be said, one idea is almost the same as the other, and it would be quite unfair at this time to detract from the importance of Bessemer's invention however much we may differ from the particular methods of application and use.

The adaptations shown in his elaborate patent of 1849 exhibit a fertility of experience and acquaintance with constructive mechanics that remains remarkable even to this time.

The controversy mentioned culminated in a challenge from Mr. Gwynne to operate the pumps in competition for a year, the losing competitor to pay £1,000 into the treasury of the London Mechanics' Institution. This challenge was not accepted.

REPORT OF THE UNITED STATES COMMISSION AT VIENNA.

A claim to original discovery of particular inventions on national grounds, is in many cases silly and provincial, but in the present is so marked, and has been so ignored, that its review will be a matter of common fairness, especially as common opinion in the matter is to some extent based on the report of the American Expert Commission sent to the Vienna Exposition in 1873. To this report is due, unfortunately, in a great measure the idea of centrifugal pumps being of European origin. This report is a remarkable one, not only in a distortion of facts, but in the ignorance of hydrodynamics which it presents.

Without wasting space to quote farther from this report, the following salient points appear (see pages 193 *et seq.*):

“(1) Appold was the introducer of this class of pumps ; (2) they are misnamed centrifugal, because they do not operate by centrifugal force at all ; (3) they operate by pressure the same as a turbine water wheel ; (4) when people understand their method of operating we may expect much improvement ; (5) they should have disc runners, because the fan wheels will soon wear out.”

This much, I think, will do. This extraordinary report stands printed in a Government publication, signed by men who were, or are, eminent in mechanics, and we can only deplore the stupidity, as well as presumption of the commission who thus disposed of a subject that had twenty years before been carefully investigated by such men as Sir John Rennie, Professor Cowper, Mr. Whitelaw, Dr. James Black, Professor Rankine, and many others. The most astonishing part is, however, that this report was passed and signed by men who we can hardly suppose would fail to perceive its absurdity.

BLAKE'S PUMP.

Returning again to American pumps, in 1831 Messrs. Blake, of the New Steam Mills, in Connecticut, invented one, shown in

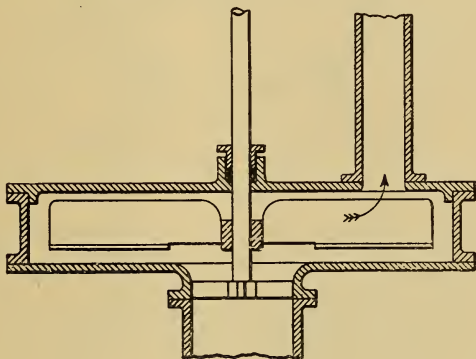


FIG. 15.

Fig. 15, and well worthy of attention here as being the first of its type, and almost identical with Bessemer's of 1845 and 1849. It is, in fact, the better machine if carefully compared, but subject, like nearly all disc pumps, to lateral thrust upon the impeller that would cause difficulty in working.

It was in every sense a "departure," and is by no means obsolete at this day for high lifts. The force of the issuing water, or its tangential energy, is lost, as may be seen by the annular casing and change of the water's course, but this loss has to be measured

by the relative speed between the wheel and off-flowing water, as has been explained. This invention has of right a prominent place in the history of centrifugal pumps.

ANDREWS' PUMP.

The next American pump to follow was that of Andrews, invented or published in 1839, the first American pump with a cylindrical discharge chamber. If the Massachusetts pump came near anticipating our best modern practice, the Andrews pump completed the matter, and leaves room for the lament of Lord Byron that "those thieving ancients have stolen all of our modern ideas."

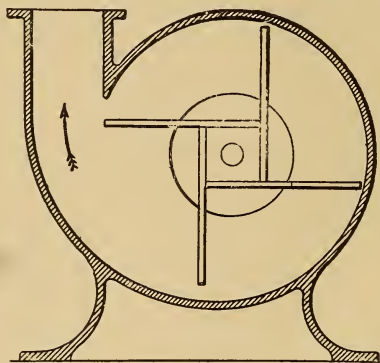


FIG. 13.

The construction, in side view, is identical with the Massachusetts pump invented in 1818, and shown in Fig. 13, which is repeated, the difference not demanding a new drawing, Andrews' invention relating to a cylindrical chamber at the vane tips. Excepting the straight vanes and one or two less important points, the pump is capable of high duty, and conforms very nearly to good modern practice for dredging purposes.

The effect of curved vanes, as has been explained, is dependent on speed or pressure, and is not a qualifying factor of the pump's duty unless pressure be included, and it is safe to claim that for low heads this American pump of 1839, made long before any such machine was known in Europe, is capable of a duty within ten per cent. of the best modern performance, and its only distinguishing feature, comparing with its predecessor, the Massachusetts pump of 1830, is a casing of cylindrical section not differing at all from

the patterns in use at the present time by several makers in the Eastern States.

The transverse section of the pump would show the "waterway" diminished from the inlet to the periphery to conform as nearly as practicable to volume and velocity; in fact it was in this respect much better proportioned than many pumps now being made and sold. This pump, let it be remembered, was produced and publicly known five years before Mr. Gwynne's experiments at Pittsburg, and at a time and place that leaves only the Massachusetts pump as a possible precedent.

We must not, however, detract from the last-named pump, further than to call Andrews' an improvement. It is a step further in the art, and a very possible invention that anyone might make, and, no doubt, a result of improvement in mechanical facilities for making the casing of two pieces of cast iron, and the water duct of cylindrical section.

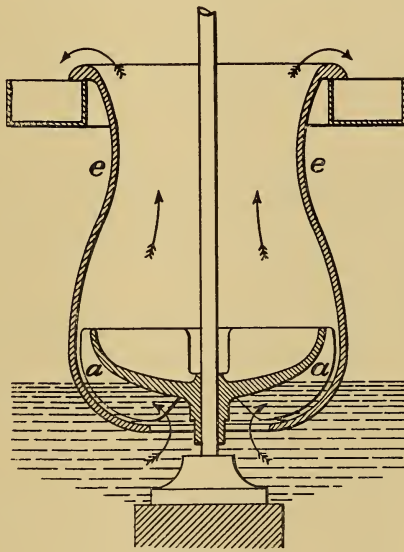


FIG. 16.

WHITELAW'S PUMP.

This brings us down to the time of Whitelaw's experiments at Johnstone, near Glasgow, in Scotland. The exact time is not known, but it was between 1847 and 1849. Mr. Whitelaw was the

inventor of a water wheel that bears his name, and his pumps, which he describes as "especially suited for draining lands," are in most respects an "inversion" of his water wheels.

Fig. 16 will give an idea of the arrangement, which differs but little from pumps erected within a few years past by thorough engineering firms in England, and also of some made from the writer's designs now in use in California.

The most remarkable feature of Mr. Whitelaw's experiments is the very complete knowledge of hydrodynamics they show. The following are four out of nine columns in tables he prepared from experiments to determine the efficiency attained by his pumps.

No. of Experiments.	Revolutions of the Pump.	Loss by Friction and other Resistance in the Pump.	Loss by Force of Water after leaving the Pump.	Efficiency. Power of Pump Motor being 100.
1	327.6	19.370	7.314	69.23
2	278.4	12.780	9.462	73.18
3	226.8	7.027	13.980	79.67
4	199.0	4.466	18.620	75.78
5	182.0	2.984	23.780	76.48

The power was measured by a dynamometer of delicate construction, and the experiments in every way conclusive. The formulæ employed in his computations can be found in the *Practical Mechanics' Magazine* of 1850.

There is an erroneous opinion existing respecting the efficiency of pumps of this kind, of which more will be said hereafter, at present I will, however, point out that the effect produced by Mr. Whitelaw with his submerged wheel was seven per cent. better than anything attained in the exhibition of 1867, and might have been much more if the up-take had been an annulus, that is, the main casing filled in, so the discharge energy would not have been lost in the large body of nearly still water above the wheel.

The next stage in centrifugal-pump history includes the experiments of Messrs. Gwynne, Appold, and Bessemer, of which some account has already been given.

The pumps produced by Gwynne we can presume to be the same, or analogous to, the one patented in 1850, and shown in Fig. 14. This pump affords room for extended comment, which must, however, be passed over here. It was the one shown in competition with

the Bessemer and Appold pumps at the exhibition, and by no means so good a one as its predecessors in America, although more expensive and complicated. In support of this opinion I have only to refer to Messrs. Gwynnes' modern practice. The discharge chamber was annular, as shown in the side view.

BESSEMER'S CENTRIFUGAL PUMP.

In 1845, Henry Bessemer, now Sir Henry, invented and patented his centrifugal machine or pump, before referred to.

It is not necessary to give drawings of this machine. It had simply an encased impeller, or "runner," as we now say in this country, revolving in a free chamber or casing, the discharge or tangential force of the water being neutralized and lost in the surrounding body or stratum. The writer has reason to understand these pumps, having himself gone through perhaps the same chain of experiments and reasoning forty years later, but with a different result. The principle or method of operating was found applicable to high heads or high pressure, the loss of power being to a great extent compensated in other ways.

The pumps of Mr. Bessemer constituted a kind of "roundabout" way of attaining a simple result, and contained some kind of a pneumatic attachment that we need not now trouble ourselves to even inquire about, and much less to describe. The pump, aside from its last-named feature, which was no essential part of it, had been not only anticipated, but exceeded by Blake's of 1831, shown in Fig. 15, which was a better and more simple machine, embodying all the operating features of its pretentious successor of fourteen years later.

I am not at all astonished at Mr. Gwynne's resentment respecting the Bessemer pump, or the Appold pump of Easton & Anderson. Both of them were, in a sense, "upstarts," as their subsequent history has proved. We must, however, concede to Mr. Bessemer, and no doubt to Easton & Anderson also, that they were not aware of what had been done in this country more than thirty years before.

In 1846, after the Andrews pump had been applied to a great variety of purposes in this country, it was improved and again patented both here and in England, Messrs. Gwynne & Co. acquiring the right for that country.

At this date we find the encased or closed impeller so nearly conforming to the present form that its invention may with all fairness be ascribed to Mr. Andrews, and claimed for this country. This has been conceded by impartial English authority of six years later, and adds another to the claims that can be made in respect to the origin of centrifugal pumps in the United States.

In the same year, 1846, Messrs. Von Schmidt, of New York, patented in this country a new modification of centrifugal pumps, an adaptation or change of the Andrews pump, but having no claims beyond its early date that need receive attention here. A glance at the drawings of the Von Schmidt pump will show that the theory of their action was not very well understood.

THE APPOLD PUMP.

In 1848, two years later, we come to the celebrated Appold pump, and the first comment must be that there was no reason for celebrity in the case. The Appold pumps were made by Messrs. Easton & Amos, now Easton & Anderson, of London, then and now very celebrated hydraulic engineers ; but in so far as Appold's pump the only new feature was the curved blades conforming to the Barker mill pumps that had preceded. Appold's first pumps had diagonal vanes set at an angle of 45° from a diametrical line, afterwards altered to those curved backward. The want of novelty in this is sufficiently proved by the fact that no patent could be procured on this alleged invention.

In some cases for low heads, where a pump's work is performed by impact, or "mechanical push," it may be called, more than by centrifugal force, curved vanes of the Appold form would not only have no useful effect, but cause a lower efficiency.

The change of Appold's wheel or disc from a tapered section, with a discharge orifice of narrow width, to one with parallel sides, shows that at least one of the main laws of hydraulics, a change of velocity without change of volume, was not known or else was disregarded. Even recently, however, one mathematical authority has assumed that the converging wheels were of no importance, ignoring the friction of the broad vane tips, over-running the water as six to one at a head of forty feet.

On the whole we are justified at this distance of time, when the merits of various methods have been demonstrated by experience, in concluding, as before intimated, that the reputation of the makers

and the contest at the London Exhibition of 1851 did more to make the Appold pump known than its working merits.

Subsequent tests, notably one at the Chatham Dockyard, in England, and one at Trafalgar Square, London, showed that however important the curved vanes might be, other features of the pump were bad or wanting. Messrs. Easton & Anderson have, however, constructed some of the best and most efficient centrifugal plants known.

The fact is that the controversy of 1851, so often mentioned here, removed the pump matter from the field of engineering investigation to one of commercial contention. In respect to vanes, for example, there were at the time in England plenty of engineers and scientific men who could have developed from mathematical data the true and best form for pump vanes at different heads.

It is true Prof. Rankine defined a form of vanes which did not give a good result under certain circumstances. I am speaking from memory, not having seen the drawings for some years past, but, as now remembered, Rankine's proposed vanes were suited for low heads only, and, no doubt, his computations were correct, as all must be if the premises are not mistaken; I may also remark, in respect to Appold's wheels, that computation would not in any case have produced vanes of a true curve such as are shown in drawings of his pumps made at the time.

Bessemer's second patent of 1849, a treatise it might be called on the general and special adaptations of Mr. Bessemer's pumps to various purposes, is an interesting study at this day. His pumps, as before remarked, can be explained by referring to Blake's pump, Fig. 15, which is typical of all the modifications in Bessemer's patent of 1849, and already sufficiently discussed. Then followed Gwynne's improved pumps, and to Messrs. Gwynnes' credit be it said, the workmanship on centrifugal pumps and the engines to operate them, reached in the hands of this firm a perfection that perhaps no other branch of similar engineering work could at the time excel. The efficiency attained with centrifugal pumps was, by this time, such that Harvey's compound direct engines, employed to drain Haarlem Lake in Holland, could have been excelled in performance at one half the original cost had centrifugal pumps been employed for the same work.

It has been extremely difficult to ascertain the dates heretofore given. They reach back but seventy-six years, but have been found in fragments, and are far from orderly arrangement here.

THE PROGRESS OF THE "ART."

It is, perhaps, in all cases unfair to indulge in censorious opinion respecting the past history and rise of an engineering manufacture, or the development of a new class of machinery, but if there ever was a case where such opinion was justifiable, that of centrifugal-pump progress is such a case.

For more than half a century the pumps remained practically where they began. "The last was like unto the first," and during this period there was mistake, retrogression and a failure to discern simple elementary principles that surpasses present belief.

To prove this, one has only to compare the first American pumps of 1818 with those now made in this country, and by Gwynne, Allen, Drysdale and others in Europe at the present day. This is enough to show how little has been changed or improved, but it fails to in any degree indicate the practice that has intervened.

The dynamical laws or principles involved in the operation of centrifugal pumping seem to present but little of the complicity attendant on heat engines, or in dealing with expansive gases. The problem is simple in comparison with the mathematics of projectiles, of turbine water wheels, or a dozen other things that might be mentioned, that have arisen and been disposed of during the time.

Centrifugal pumps have gone through a development of experiment by mechanical expedients, a method generally slow and uncertain, not wholly so, however, because in 1848 we find Mr. Whitelaw making computations involving all the principal conditions of centrifugal pumping. Still further on, however, we find the celebrated Mr. Rankine suggesting curves for the vanes of such pumps, at variance with the almost universal Appold form.

Encased impellers have been one of the stumbling blocks over which nearly all pump makers have made their way. Blake, Gwynne and Andrews in America, and Bessemer in England, have all contributed to this error, if error it be, and within a few years past the same old round has been gone over again by a firm in Massachusetts that adopted the Gwynne pump in other respects, but at first employed a Bessemer or Andrews impeller. In a recent number of the *Engineer*, London, appears in an advertisement various sizes and adaptations of centrifugal pumps, all constructed with encased impellers. The writer and some other makers in California followed the same course, and, as before remarked, this thing

has been taken up and at some time abandoned by nearly all prominent makers of centrifugal pumps.

The causes for this are not difficult to trace. There has always been a desire, for commercial and other reasons, to employ a single inlet at one side of the pumps. This simplifies the construction, saves a great deal in first cost, makes the water-ducts more direct and free, and all parts more accessible. To accommodate this construction, seen in Mr. Gwynne's pump of 1850, there was difficulty in balancing the inclosed wheel, that is, compensating for the draught on the inlet side.

Open vanes, like those in the Andrews pump of 1839, avoid the thrust, but such vanes to be made of cast material require a web or diaphragm to support them, and as soon as this was introduced the thrust became destructive, not only equaling the indraught or suction, but the whole area of the back of the disc or diaphragm became subject to a pressure equal to that in the discharge pipe.

There is a recognition of this difficulty by Mr. J. S. Gwynne in 1850, and his ingenious attempt to balance inclosed impellers by a vacuum or free space at the back. This is very complimentary to his engineering insight at the time, and it is a question now whether there is any true understanding among engineers of the function to be performed by the balancing chamber described in his patent of 1851. It seems to be a vacuum chamber to balance the draught of the suction, but is, in fact, to protect that much of the area of the back of the impeller from the pressure within the casing.

This subject was discussed in a paper read before the British Association, at Norwich, England, in 1868, by John and Henry Gwynne, and, since that time at least, open impellers have been a constant feature of their practice, and is no more than a return to the principle of the Massachusetts and Andrews pumps of forty years before.

The adoption of open wheels or impellers, it was supposed, called for a double or balanced suction, as the single inlet forced the employment of an inclosed or double-disk runner. It was a cycle of experiment running over a period of forty years, and ending where it began, if we do not include the form of the vanes.

Nothing has been said of French practice, and the writer must confess to some prejudice in the matter, because of certain reports about the year 1866, when there was a competitive test of some Gwynne pumps with those made by M. Coignard, of Paris. The Gwynne pumps were set down as working at a duty of 35 per cent.,

while the Coignard pumps realized nearly double the same effect. Looking at the construction in the two cases, and making such deductions as a fair inference would afford, we must conclude the report was of no value, and its statements impossible. Since then M. Farcot, of Paris, has produced some fine examples of centrifugal pumps for various purposes, some of them to operate against a head of 30 meters, and large pumps of excellent design, such as have been erected on the River Nile in Egypt.

French engineers have developed a good deal in compounding pumps, and, I believe, first invented the double or multiple impellers, one discharging into another, to be used in the case of high heads. I am not sure, however, whether Mr. Gwynne's compound pumps were first proposed or not. It is not a matter of much importance either way, because, all things considered, it is doubtful whether compounding is a construction to be recommended beyond certain exceptional cases. The problem involves questions not answerable by computation. It is one of mechanism and endurance, which future experience must determine, so that if added by our French friends to modern pump practice it must stand as a feature of questionable value.

While, as pointed out in the beginning, the invention of practical centrifugal pumps belongs in America, their development and application in an extensive way was for a long time mainly the work of English engineers. The draining of marsh and overflowed lands, and for graving docks, are the principal purposes to which the larger class of centrifugal pumps are applied, and neither of these wants had, down to ten years ago, existed to any extent in the United States.

The draining, irrigation and reclamation of land, while it is to some extent owing to the physical circumstances of a country, is mainly a matter of the value of land and its scarcity. In some cases, as in California, to great fertility, but except on the Pacific Coast there has been until very recently no need of water-raising for these purposes, at least not enough to cause, as in Europe, a complete development of the most suitable machinery for the purpose.

At present there is a change going on. The cultivation of rice in the Southern States, and of cranberries and some other crops in the Northern States, the enhanced value of marsh land near large cities, and the greatly increased value of alluvial plains, begin to call for the development and improvement of water-raising appliances.

(To be continued.)

EXTRACTS FROM A NOTE-BOOK.

BY "TECHNO"

No. XXV.

HOW A STEAMBOAT FINDS ITS WAY.—THE TIPPECANOE ESTATE.

GENERAL HARRISON ON ANCIENT MOUNDS.—A LEARNED

PRESIDENT.—"WHEN DEAD HOW SOON WE ARE

FORGOT."—A TOBOGGAN FEAT.

————— My Uncle Camshaft, before he went to sea, was a river engineer, and always claimed that it was the best school in the world to teach a man what he calls "emergencies."

The art of emergencies, so to speak, is one contingent on human nature, an inborn trait. Some men are never so cool and composed as in a "scrape," the intense activity of the mind in excitement takes the normal course of reasoning; in others explodes, so to speak, scatters, and becomes idiotic, still training and example have much to do with the matter.

Steam-boating in the early times, and even now what is left of it on the Mississippi and its great tributaries, is full of "emergencies." When at sea one becomes nervous as soon as land is neared, but here a great boat that will crush like an egg shell, goes thundering along on the darkest nights, and in wild storms, between two shores within hailing distance, past snags and wrecks, over bars, around bends, in some mysterious manner no one can explain.

Before we reached St. Paul, I asked my Uncle about this matter of steering at night, and did not get much satisfaction, his remarks were something as follows:

"That's the old question, the first one a landsman asks, and the last one a boatman answers, and that has never been answered in a manner to convey much information. A pilot can't tell you how he finds his way; in fact he don't know, and does not dare to study about it. If he did he would get scared, and produce an "emergency." There is an intuitive perception of where you are that arises from a variety of things, that would make up a quadratic equation.

"First there is time, an unconscious measure of how far you have come from the last point; there is sound, not an echo, although that sometimes is observed, but a kind of reflection of sound from the shores, and there is the hill line or timber line always visible, except in fog; also the appearance of the water or reflection from it, and

finally the feel of the boat. Any depth less than twice the draught is 'felt.' The vibrations change, the engines slow down, and the stern sinks or seems to whenever the water shoals, because of water piling up at the head. I cannot tell you nor can any one else, how a pilot finds the way, but we will see all this as we go down the river.

"I don't like this St. Paul arrangement at all, you will miss a good deal. The Ohio River is the ideal one for steam-boating, comfortable, calm and beautiful at common stages, but outrageous in its fluctuations.

"Jo Cowell, an English actor, who traveled here before Dickens did, described the Ohio River as a 'thousand miles long, a mile wide, and eighteen inches deep, frozen up for one half the year and dried up the other half.' He was here in the summer; six months later he might have seen sixty-three feet added to the depth. The rise and fall in the middle section, about Cincinnati, is sixty-three feet. I have steam-boated all day over cornfields in the lower river, and six months later seen a boat 'spered' over the bar at the 'Grand Chain' at the same place, or near it, but it is a beautiful river. For eight hundred miles from where it begins at Pittsburgh, there is not a break in the green hills that form its boundary. Never did a river show out such an uniform bed. It is like a keyway in a long shaft. The sedimentary lands shift from side to side, but the whole width between the hills is the same, and even their fertility is invariable. Except at Louisville, there is not a rapid or ripple in the thousand miles that a child could not row a boat over."

I was of course much interested in this account of the Ohio, and managed its continuance. The River is full of legends, Indian and other. It is a frontier line between the North and South, and I much regretted our trip had not been down the Ohio Valley, but as it was, a good deal was learned, here is a continuance :

"At North Bend, near Cincinnati, sixteen miles below, is, all things considered, one of the most romantic places on the river. I don't use that term in its common sense, for happily there are no romantic places in the way of rugged inaccessible cliffs, not worth a dollar a square mile, which seems to be the main characteristic of romantic places. Here all is peace, the lands are tillable, the hills climbable, and the water everywhere accessible, flowing quietly and available for navigation and drinking.

"At North Bend is a pass about one hundred feet high, a notch in the hill between the Ohio and the Big Miami Rivers. The latter

joins the Ohio six miles below, but at the 'gap,' the Ohio bends to the North and the Miami to the South, so the two rivers come within half a mile of each other divided by a ridge through which a tunnel was made about 1840, for the passage of a canal, but the main thing of interest to be pointed out here is that this was the estate of General Harrison, elected President of the United States in 1840, and bothered to death by office seekers a short time after.

"It was a grand estate, lying between two rivers for a distance of seven miles, averaging a mile or more in width, a high ridge or hill of 300 feet elevation, extending all the way, except at the pass where the General's log cabin was situated on the Ohio side. This old cabin, a real log one, where the General lived, was burned down about 1860, the foundations yet remaining to be pointed out to the curious.

"Set down in those notes, which are no doubt to become permanent in the annals of this country, that the ninth President of the United States was and is a stranger to his countrymen. They have never known much about him.

"It is a common impression in this country that the log cabin President of the United States was a wild, hard-cider candidate from the uncultured West. Never was there a greater mistake, General William Henry Harrison was, judged by fair standards, the most learned man that ever sat in the presidential chair. I know that most people will laugh at such a proposition, but it is true. Who besides, among the Presidents of the United States, has been a learned man? What are their legacies in the way of science, art or even law? A politician is never a learned man, or to state it better, a learned man is never a politician. George Washington was far and away the most thinking man, down to Harrison, and he was both thinking and learned, he was a profound thinker, and his views were qualified by scientific attainments of a high order.

"In proof of this, there is on record a paper of his, contributed to the Cincinnati Historical Society about 1836, on the probable age of mural remains in the Ohio Valley, that is, or ought to be a classic in our language. I defy anyone to produce an essay that, aside from a wonderful diction, gives more evidence of analytical thought.

"On the General's lands, at the summit or point of the ridge near the junction of the Ohio and Miami Rivers, is one of those ancient mounds, a most wonderful one, that General Harrison investigated in a true scientific way. It belongs to the class called military, a fortification in fact, enclosing seventeen acres. The walls

are now in places more than six feet high on the inside, the outer angles being most of the way a continuation of the steep hill sides. It overlooks vast plains of fertile land for many miles every way, had bastions and towers, also great cisterns to contain water or grain, or both, the inner walls of these being burned clay, and solid and hard, even now.

"The General had one of these excavated and cleaned, also made careful maps, not only of this, but other works of the mound-builders, which are thick thereabout, the great one at Miamiville being only a few miles away. His paper on the subject of these mounds, as I have claimed, is a classic in our language, also more cogent in character than anything in the *Monuments of the Mississippi Valley*, by Squier and Davis.

"The premises from which age was inferred, was the timber growth, especially on the works at fortress point, on his own estate, and were most ingenious. It is many years since I read this paper, but the impression on my mind was such, that I can repeat the substance of it now. The General says: 'When the land is denuded of its verdure, as was necessary in erecting these vast works, and when after their term of use, the natural forest began the work of again clothing the land with trees, there was a cycle of changes, such as is observable to all in this country. The first growth is not that of the surrounding forest, but is usually of but one kind of timber. This in turn yields in part to destruction by lighting, insects and other causes, and other species take the place of the destroyed trees. These changes go on until at the end of a period within some bounds of conjecture, the forest on the denuded area assumes its original character and diversity. At Fort Hill there is no discernable difference between the forest inside and outside the works. On the walls stand the same trees as in the forest around, and of the same size and diversity, and from this we may gain some clue to the period that has elapsed since the works were erected.'

"Now I do not know that one sentence of this is exact, but it is the idea, clothed in less perfect language, and I ask who among our political presidents has been capable of such a paper? General Harrison took a great interest in the speculations of his brother-in-law, John Cleves Symmes, the 'hollow-world man,' who is buried nearby the General's tomb, and has on the top of a marble column at his grave, a sculptured hollow globe. I do not know that General Harrison accepted the views of Symmes, but we know he was

a military man, a jurist and a scientific man, who left on the country around a profound respect for his learning.

"Log cabin, forsooth! Those rough hewed logs plastered with mortar to fill the cracks, and roofed with riven boards, surrounded more learning and honesty than can be extracted from forty palaces, occupied by public men of our time—and think of the scant honor it brings to his memory!

"The General, by his request, was buried on an eminence near his old log cabin, overlooking the wide sweep of the Ohio, and visible for miles from passing boats. They built up a plain rectangle of brick, about four by eight feet, and put a large stone on top, also put a picket fence around the grave.

"The estate fell into other hands, much of it, and finally only one representative remained, the Hon. J. Scott Harrison, father of the late President, who lived at the 'Point,' and who by ill health, could not attend to more than his own home. The fence around the General's grave rotted down, the hogs got in, and by rooting around the shallow walls, caused the brick-work to crumble, and our country came near the disgrace of having their most learned and virtuous president rooted out of his grave by swine.

"The governor of Ohio, by a communication to the State legislature, secured an appropriation to repair the grave and grounds, which was done about 1868.

"If a man feels constrained to do any great act of a public nature, and has any pride in the perpetuation of his name, he should at once get out of a republic, or out of this country at least, where as Rip Van Winkle says, 'when we are dead, how soon we are forgot.' Of course, one of my pursuits has a first regard for all kinds of learning connected with natural sciences, and why not? Nothing is more ridiculous than a man with his head crammed full of the Greek and Latin classics, walking around blind. The movements and forces of nature are to him a sealed book. He does not know what anything is made of. The animal, vegetable and mineral elements are to him, dogs, horses and sheep, trees, potatoes and grass, wood, iron and coal, only this, and nothing more. Movements are to him profound phenomena, inscrutable mysteries, not catalogued with the Greek and Roman Gods, or the phantoms of rhapsodical nonsense. I do not know if General Harrison was a Greek and Latin scholar or not, or if he had acquired a knowledge of metaphysics and moral philosophy. But of one thing we can be sure, he knew how to construct a tunnel on scientific

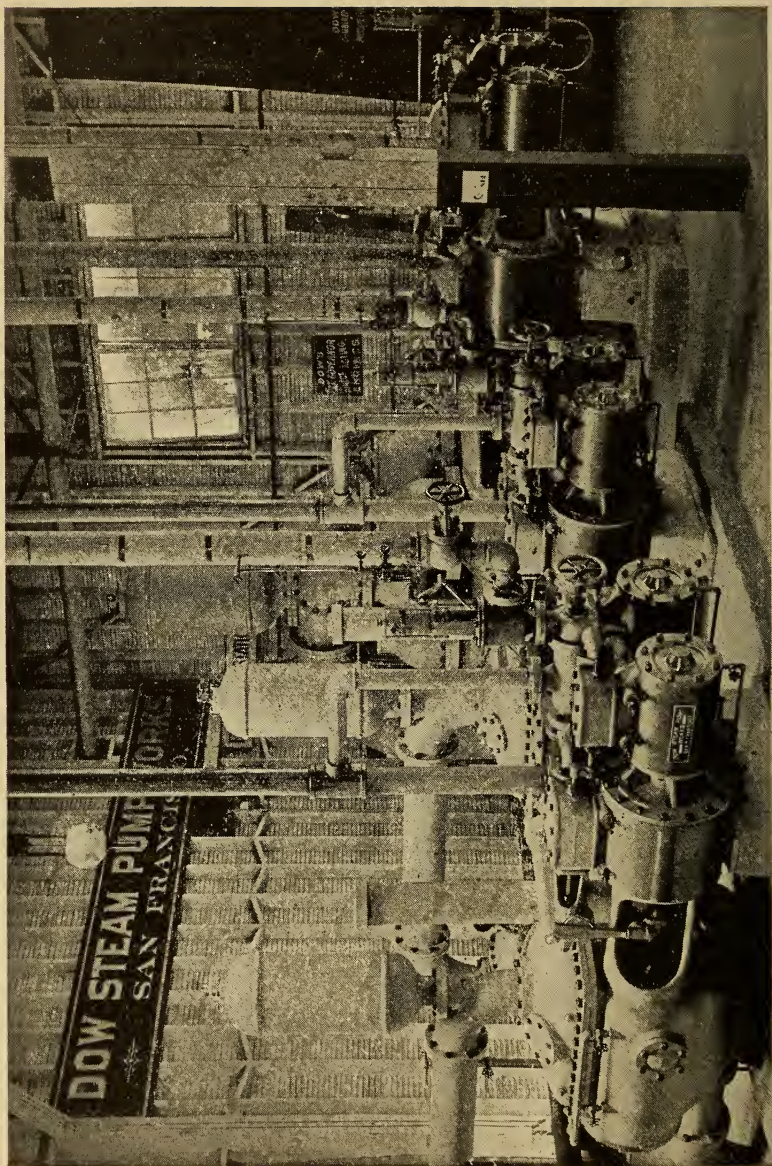


EXHIBIT OF THE DOW STEAM PUMP WORKS.—MIDWINTER FAIR, SAN FRANCISCO, 1894.

principles, also knew the essential elements that should enter into the administration of human government.

"One thing he did not know was the angle of repose, or the angle of stability for loose soil, or if he did, he rode without his transit one day when his horse slid from the top to the bottom of an embankment, at Cleves, when the tunnel was being made there, fifty feet or more, without unseating the General. It was a fine feat, well remembered in the neighborhood, and told of to this day by old residents there, if any are left now, which I doubt."

(To be Continued.)

EXHIBIT OF THE DOW STEAM PUMP WORKS.

MIDWINTER FAIR, SAN FRANCISCO, 1894.

About two years ago we commented upon an attempt being made, and fairly carried out at that time, of organizing a systematic manufacture in the Dow Steam Pump Works, of this City. Since then the work has been still farther reduced to system, and has enabled a recent feat that could hardly be equalled in any of the works at the East.

When it was decided by the General Electric Company to erect the great fountain at the Midwinter Exhibition held here, there was a problem of how to provide a water supply equal to seven and a half millions of gallons a day under a pressure of 86 pounds per inch, or a head of 200 feet. The Dow Steam Pump Works undertook the contract for delivery of the required machinery in twenty-six days' working time, and in that time constructed and had erected on their foundations three compound direct-acting duplex pumps of the following sizes, the third dimensions named being the diameter of the water cylinders.

One pump.....	14 × 24 and 16 × 18 inches stroke.
" "	10 × 18 and 14 × 12 " "
" "	10 × 18 and 12 × 12 " "

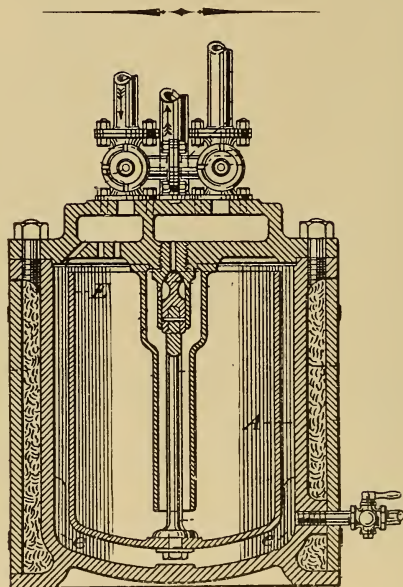
These pumps formed one of the most remarkable exhibits at the Exhibition, and will be remembered by all who visited Machinery Hall. The castings were smooth, the designs thoroughly symmetrical, and the whole painted without ornamentation of any kind.

The pumps were controlled by pressure, and speed-governing apparatus provided with relief valves, so as to secure automatic action, and avoid the shock or concussion of interrupted flow due to

suddenly opening and closing the valves at the fountain, which was continually going on in changing from one effect to another.

The thoroughness of design, and excellence of workmanship, was attested by the fact that no accident or interruption of any kind occurred during the whole time of the Exhibition, not even a joint of any kind was remade. It was a confirmed success, creditable alike to the works and to our City.

Notwithstanding the system introduced in these works, and before alluded to, one is amazed in looking over the extreme diversity of dimensions and designs called for in such a business on this Coast, and when to this is added the large number of special designs furnished by the Dow Works for the war steamers constructed here, it becomes an example of how far system can be carried even in a diversified line of work.



VERTICAL SECTION.

MARINE WATER TRAP.

MESSRS. W. T. GARRATT & CO., SAN FRANCISCO.

Mr. John McKellar, of this City, a retired steam-engineer of wide experience, has for two or three years past given especial study to what are called "steam or water traps," not an extensive, but an essential detail of nearly all kinds of steam apparatus.

Mr. McKellar being a practical man, has managed, as practical men commonly do, to get along with about one half the details commonly thought necessary for such traps, but retaining all the required functions.

His traps, as made for common use and ordinary pressures, were illustrated in No. 50 of this Journal, and have been very successfully made and sold for several years past, but having received orders for some to be employed on war vessels, it was found that modification was required, and the design shown in the section opposite was prepared for marine purposes.

The principal points of difference from the land modification, is in mounting all the operating details on the cover, instead of the cover being entirely free, as in the first form; adding to all the proportions affected by higher pressure; providing for "blowing through" in all possible directions, and covering the main chamber with felt and lagging to prevent the radiation of heat.

Of three pipes seen at the top, one is an inlet, one an outlet or waste pipe and the other a blow pipe, the courses of the steam or water being controlled by two-way and three-way cocks on the cover to which the pipes are attached. The float-valve and other details will be tolerably clear from the drawing, except as to provision in the valve and its seat to prevent noise when the trap is discharging its contents. These consist of small diagonal perforations around the valve guide at the neck, and a cruciform section below the point of the valve.

These traps are perhaps the most simple of the intermittent discharge class, and have met with much approval by the U. S. Naval authorities and by marine engineers generally.

They were patented by Mr McKellar some time ago, and are made by Messrs. W. T. Garratt & Co., of this City, who have at one time or another manufactured water traps of almost every modification known.

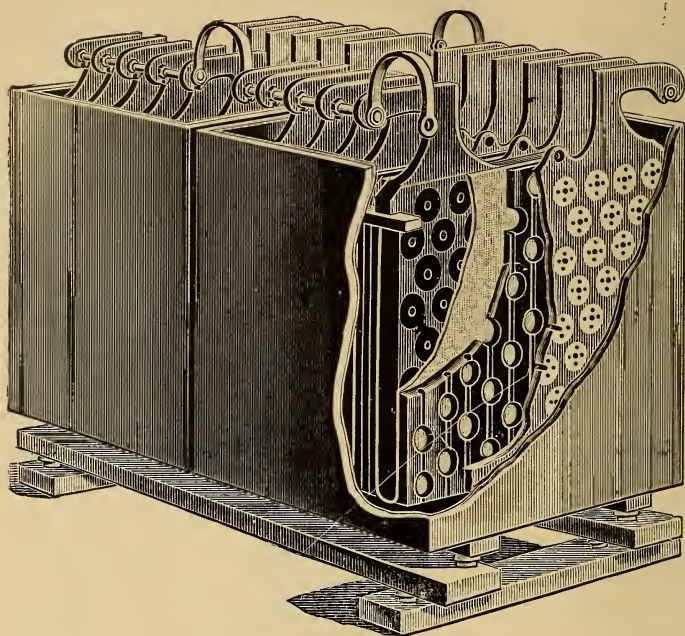


FIG. 1.

CHLORIDE ACCUMULATOR CELL.

THE ELECTRIC STORAGE BATTERY CO., PHILADELPHIA.

We have received from the company above named, a pamphlet relating to what is called the "chloride accumulator system," such as is employed in Paris, where these batteries are used for traction on two suburban railway lines of $5\frac{1}{4}$ and $5\frac{3}{4}$ miles in length, with economic results that are very satisfactory.

It has been claimed a good many times, and is unquestionably true, that electrical storage is much behind in this country. A letter received from an eminent engineer in Switzerland, at the same time with the pamphlet above mentioned, goes to confirm this fact. The following quotation from this letter will be appropriate here :

"I. know that storage-battery practice is looked upon in the States as a failure. This is in a great measure owing to the intrigues of the over-head wire interests. (We think here that these large monopoly companies are a great evil.) On our side of the water the storage battery system is progressing very satisfactorily ; the most successful so far is the system at work on the Tramways

Nord, of Paris. This company started five experimental cars some two years ago, now they have twenty-five, and some seventy on order. The batteries weighed at first about 2,800 kilograms, now they weigh only 1,350 kilograms for the new cars, and they can run 140 kilometers per day, with twice charging. This is progress!

The engineer who controls these experiments writes me that 'at this time we have succeeded in bringing down our traction expenses to the same figure as the over-head wire people, and have nothing further to fear in this direction, and I believe these expenses will continue to decrease, as improvements are cropping up daily. The past justifies the hope that in another year we can more than hold our own against the over-head wire.'

This quotation is from a private letter, not intended for publication, and from an authority as high as can be referred to at this time, in any part of the world.

The chloride accumulator, like all others, has for its active element peroxide of lead, prepared at first as a salt of lead in the form of pastilles. Around these pastilles is cast under heavy pressure

the main plate or frame as shown in Fig. 2. Quoting the company's circular, they say :

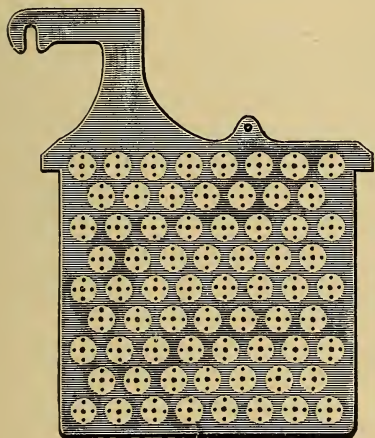


FIG. 2.

"We now have a plate entirely composed of metallic lead, partly in compact form, partly in minute crystalline subdivision, differing from a plate of cast or rolled lead only that some of its parts are of a crystalline character, a difference purely mechanical, in nowise chemical, the same plate which Planté used in his original discovery, except for this important mechanical difference.

We then put these plates requiring oxidizing, with alternate lead plates, in a cell with an electrolyte, and pass current through them for

a sufficient time to convert the pure crystalline metallic lead into peroxide of lead.

'It is well known that in a crystalline form the molecules of matter are arranged in a different order from what they are in any mechanical mixture. In the mechanical mixture the aggregation of the atoms is strictly fortuitous; that is to say, it is a mere question of chance how they are arranged, and they have no cohesion among themselves beyond that which is given to them by the cementing mixture which holds them together. In the crystalline form, however, all this is changed; the molecules of the body are arranged in

perfect symmetrical order, and they are held together by molecular affinities which regulate the order of their distribution and secure the coherence of the mass. It is quite true that the material is denser unless some means are employed to modify the density; but although this is the case, the molecular channels which exist in the interstices of the crystals are arranged in as regular order as the molecules of the crystals themselves."

By this construction it is claimed that weight for a given capacity is much reduced, as stated in the communication before referred to, and that the porosity permits a rapid discharge, in one or two hours if necessary. The technical functions of the batteries are set forth at great length, graphically, but our space will not permit the use of the diagrams here. The same reason applies to most of the information published by the company, which we much regret, especially that portion relating to storage batteries in central stations and for traction purposes.

DISTRIBUTION OF HEAT.

Some very careful experiments have been made with a steam boiler in London, by Professor A. B. W. Kennedy, and Mr. Bryan Donkin, Jun. The boiler was of the Lancashire type, having, however, 52 tubes of 4 inches diameter, 7 feet 3 inches long, forming a rear extension of the main or furnace flue. The boiler is in use in the printing department of the *Daily Telegraph*, and was designed by Mr. W. H. Maw, editor of *Engineering*, London. The results, which are set forth in elaborate lists, show in experiment No. XX, with "standard coal," evaporation per pounds of coal, 9.45 pounds of water from feed temperature, equivalent to 10.35 pounds from and at 212 degrees. The heat "balance" is given as follows:

Heat Evolved.	Per Cent.	Heat Absorbed.	Per Cent.
Heat from pure and dry coal	100	Heating and evaporating water	66.6
		Heating furnace gases ...	17.2
		Evaporating moisture in coal	0.1
		Radiation	8.0
		Heat in fire drawn.....	0.1
		Lost by imperfect combustion	1.0
		Unaccounted for.....	7.0
Total	100	Total	100.0

LITERATURE.

A Dictionary of Electrical Words, Terms and Phrases.

BY PROF. EDWIN J. HOUSTON.

Published by the W. J. Johnston Company, Limited,
253 Broadway, New York.

It was a happy thought on the part of Prof. Houston in 1888-89 to prepare a dictionary of electric terminology, fortunate in two respects. First, there was great need of such a work before, at and since that time, a need that became more pressing as the art went on, and the accumulation of technical terms increased. Secondly, because of all those engaged in the study of electric science and art no one was better qualified to carry out a work of this kind.

The scholarly nature of such a book, its tediousness and uncertainty, with the inevitable criticism that all lexicographers must endure, called for an unusual temerity on the part of the author. Not only were these difficulties present, but one never before to be dealt with, an art changing and expanding so rapidly that three editions in as many years have been necessary.

The present, and third edition, is much extended and includes more than six thousand words, terms and phrases, arranged with all the care and system known to lexicographic art. The terms are set in "bold face" type, and whenever required for technical explanation engravings are added, the latter amounting to 582 in number.

Next to the labor of compilation the most astonishing fact is the large outlay involved in its publication. A volume of 667 pages, 10 × 7 inches, printed in the finest style on heavy finished paper, is when of solid text not a small undertaking. As a lexicon this work is immensely increased both in cost of composition and in proof reading, and when we remember that the matter is devoted to one branch of technical art, scarcely more than two decades old, the publishers have certainly earned commendation from all parts of the world.

The method of the work takes fully into account the technical nature of the subjects or terms. Opening the book at random we find "Radiant Matter":

"A term proposed by Crookes for the peculiar condition of the gaseous matter which constitutes the residual atmospheres or high vacua.

This is now generally recognized as a fourth state of matter, these four states being:

- (1.) Solid.
- (2.) Liquid.
- (3.) Gaseous.
- (4.) Ultra-gaseous or radiant.

The peculiar properties of radiant matter are seen in the mechanical effects of the localized pressures produced when such residual atmospheres are locally heated or electrified."

Besides this, more explanation, quite an essay indeed, with several engravings. This is, of course, one of the most intricate terms, and requires such treatment, because there is little understanding of the obscure elements dealt with.

"Hysteresis" is rendered:

"Molecular friction to magnetic change of stress.

A retardation of the magnetizing or demagnetizing effects as regards the causes which produce them.

The quality of a paramagnetic substance by virtue of which energy is dissipated on the reversal of its magnetization."

Terms accepted and added to electric nomenclature since the last edition are arranged in an appendix of 104 pages, prepared with the same care and completeness as the main body of the work. The price of the book is five dollars, and is one half as much as is commonly demanded for publications of this nature and extent.

The Mineral Industry.

**Its Statistics, Technology and Trade in all
Countries from the Earliest Times
down to 1893.**

EDITED BY RICHARD P. ROTHWELL, C. E., E. M.

[Editor of the Engineering and Mining Journal.]

The *Engineering and Mining Journal*, until last year, issued a special edition annually, containing the principal statistics and facts of the industry for each year. This, with the growth of the mining interest, and the inclusion each year of a wider field, rendered that method of publication impossible, because of expense, also undesirable in form, being too large for binding and inconvenient as a reference.

Last year was issued in book form Vol. I, containing a vast array of statistics, not only covering the business of the year, and of this country, but of all countries where the mineral industry exists to any considerable extent, also containing the total product of minerals back as far as historic records were available. This year the second volume is issued, containing, as a new and valuable feature, elaborate essays on various branches of the mineral industry by men eminent in these branches, covering statistical, commercial and technical features.

Considered in all its elements and features the present volume is the most extensive work of the kind that has ever been undertaken as a private enterprise, we mean a publication directed to one branch of industry, and, in a large degree, to what is continually changing in that branch, its statistics and processes.

The agencies that go to make up a work like "Mineral Statistics" have to be tentatively and cumulatively developed. The experience and facilities of the able editor are well known, so also the forty or more writers in this and other countries that have contributed the sections bearing upon particular countries, localities and industries, insuring confidence in the results here spread out over nearly nine hundred pages of matter.

It would be hard to select, among the various sections, one for special mention. Estimates will vary as the reader is interested in, or acquainted with, the subjects treated upon, but of the whole work there can be but one opinion, and that of hearty commendation.

Vol. I is an invaluable reference, and the present Vol. II is that and something more, because of the larger amount of historical and descriptive text. The price is \$5.00. Orders can be sent to the Scientific Publishing Company, New York.

Santo Domingo.

One of the most interesting bulletins issued by the Bureau of the American Republics is No. 52, relating to Santo Domingo or St. Domingo, as we commonly say.

This large Island, containing 28,250 square miles, comprises the Republic of Hayti, and lies off the entrance to the Gulf of Mexico. The greatest dimension is 260 miles, and the other way 165 miles. The population is

about 600,000, of mixed Spanish, French and Indians.

It was on this island that Christopher Columbus landed in December, 1492, generally accounted as the discovery of America, but it was not the first or even the second discovery of the kind. Asiatic people had been crossing at Behring Straits for many centuries, likely for thousands of years, had made their way all over the continent, and out to Santo Domingo. Later on, in the twelfth century, came the Scandinavians two hundred years before Columbus landed in Santo Domingo.

There is a finely executed map with the bulletin, and a full account of the history, geography and trade of the island. The book is printed in library form, uniform with other literature issued by the Bureau.

The Nature of the State.

BY DR. PAUL CARUS.

The Editor of the *Monist* has in this short essay of fifty or more pages foreshadowed a line of thought which must in the near future engage a large amount of attention in this country.

The late strikes passed beyond the usual field of such disturbances, and have dipped deep into the treasures of corporations, and still deeper into the pockets of taxpayers, and thus have set up almost the only incentive that will cause people to stop and think.

The restraining power against physical disturbance is the "State," using that term in its comprehensive sense, meaning laws and the means of their enforcement, hence at this time the State becomes a proper subject for consideration. The present work is a contribution to such investigation, not wholly adapted to popular reading, perhaps, but it discloses the base on which a superstructure of rules and laws are erected.

Dr. Carus is the last man to analyze actual laws, and much less law making, with the circumstances connected with a code, but his studies preëminently fit him to consider the "State" as a source from which the rules of law may proceed, and, as before remarked, now is a time to study these subjects, when the problems of the day relate not so much as to what the laws are as what they ought to be.

The essay is published by the Open Court Company, at Chicago. Price 25 cents.

LOCAL NOTES.

The *Mining Industry*, of Denver, that does not pretend to ponderous essays that exhaust current topics, comes to us this month with articles on the great strike that contain more common sense than anything met with in the learned serials of the Eastern cities. Denver has been for some time past a fruitful field in which to study labor disturbances, but the editor is not dependent upon his environment for opinions, and has evidently watched for many years past the gradual growth of the forces now in rebellion. The average press contains little or nothing worth reading on this subject. A space writer has no resources that reach into a field of this kind, and inductive conclusions form no part of his wares, so that a really logical and truthful essay on the subject of strikes and industrial disturbance cannot fail to be appreciated at this time.

Various daily newspapers, nearly all of them indeed, have, at some time in their history, produced special numbers, more or less a marvel both in extent and character, but it remains for a western city, with a population of less than 20,000 to, as we believe, eclipse all efforts in that line. The Atchison (Kansas) *Daily Globe*, on the 16th of July last, contained twenty-six pages of matter printed on fine paper, embellished with hundreds of finely executed photoplates, among these one hundred and seventeen portraits of citizens there. The subject matter consists of a history of Atchison. It is well written, well arranged, and is a severe contrast with even a hundred pages of zinc-block "smudges," and adulatory "hog wash," as Mark Twain would call it. The press people should send for a copy and compare. The price is 15 cents.

The Union Gas Engine Company, of this City, are fast increasing the power and size of their engines, and now make with all confidence those of a capacity not thought of two years ago. They have new patterns for, and are making, single-cylinder engines of 35 to 50 horse power, or in pairs up to 100 horse power, and a glance through the erecting shop will lead one to think they are in a heavy steam engine works. There is now being finished a marine engine of 70 horse power that is a good example of machine design

thoroughly worked out. There are two cylinders of 14 inches bore, with a stroke of 22 inches, the cranks being set opposite so the reciprocating weight is counterbalanced, thus avoiding vibration. The proportions are massive in all parts, the bearing of brass, the forged parts of steel, and the workmanship of a high grade throughout. The weight of the engine will exceed 20,000 pounds, including a heavy fly wheel and all the required details for carburetting, igniting, cooling and so on. We expect in a future number to give a more detailed description of these engines.

The correspondence method of education, founded by the Colliery Engineer Co., at Scranton, Pa., is fast going to fulfill a prediction some time ago made in this Journal that the scheme marked a new method of education destined to become universal. It consists in direct and specific instruction as distinguished from general or popular information derived from reading and self study, and includes in a great degree all that is done in colleges at a small part of the outlay in money and time. The students set out to educate themselves the same as they must in fact do in a school or college, but communicating with their instructors by mail, thus employing in a most thorough manner that method best of all for training the intellect and memory by a written and permanent record of the progress made. It is a great scheme, with possibilities that are amazing when we consider them. Just at this time we have received a number of explanatory circulars impossible to examine in any satisfactory way before another issue. We, however, note that there is an enrolled membership of more than 4,000 in the School of Mechanics and Industrial Sciences alone.

The truckling servility of the various articles on the late strike that are now showered upon us in magazines and otherwise will do nothing toward allaying the causes that led up to the strike. The *American Engineer*, for August, almost alone, comes this month with a fair review of the circumstances, and wholesome suggestion for the future. Mr. Forney is a veteran in both journalism and the development of industry in this country, and his journal, sixty years founded, does not need the adventitious aid of pocket opinions. He draws a wholesome lesson from the experience of other countries in respect to labor disturbance, and indicates the road we will be obliged to follow in future, one of common sense

and common justice. We may also mention the *Mining Industry*, of Denver, and no more, among the serials of the month that have contributed anything useful in the way of allaying labor disturbance, and avoiding the violence that is a common sequence of strikes in this country.

We have received from the Hon. D. W. Voorhees, Chairman of the Senate Finance Committee, voluminous documents containing answers to a circular sent out to obtain facts and opinions respecting the tariff. As these circulars were sent to manufacturers in certain lines of production, the answers can well be imagined. They naturally follow and reflect the personal interests of the writers. We have before this argued the utter uselessness of such opinions, in so far as forming any basis of legislation, but they contain a good deal for amusement, and also, in many cases, important truths and suggestions. One thing is clearly shown, that not one man in twenty reasons beyond his environment. Some want a prohibitive tariff, never thinking of how a revenue is to be collected ; others want a revenue tariff, but the main thing is that all want a tariff on what they sell and free trade for what they buy. Such evidence, if evidence it can be called, is *ex parte*. A sugar planter wants a duty on raw sugar, and a refiner wants a duty on white sugar. The Trenton pottery maker wants fifty per cent. on his wares, and the consumer wants it off.

Among communications gone over, the following from the Dodge Manufacturing Co., Mishawaka, contains one of the principal truths met with :

“To us the cause of the stringency during the past year does not seem to be mysterious. Under the system of business in the United States very few producers have in their capital cash enough to carry on their business. They put all their cash into plant, material, and finished product. They necessarily sell on time and take commercial paper, which somebody must carry. Not having cash to carry it ourselves, we sell it to somebody who has his capital in cash. Thus one set of men put all their capital in plant and product and another set of men put all their capital in cash, and the former could not run a month without borrowing from the latter. If the latter decline to loan or buy the commercial paper, which is the same thing, the wheels must stop. That appears to be the whole story. The owners of money last spring determined to lock it up. The owners of plants and products were simply compelled to stop. The owners of money may have been unnecessarily scared.”

COMMENTS.

The war between China and Japan now furnishes a theme for all kinds of opinions and conjectures in this country where we know about one fourth as much of these countries as we ought to know. This is especially true of China. We are not speaking of books, records or statistics so much as popular knowledge, hence the present war is mysterious. Japan, it is believed, has a population of 35,000,000, and China ten times as many. This discrepancy does not seem to be much considered in the chances of success, and indicates how far machinery has taken the place of hands or bodies, as we may say. In times past a war under such circumstances could have had but one issue, but since Frederick the Great, of Prussia, fought all the nations around him for thirty years, war has become less and less a problem of numbers. It is true that in the case of China and Japan there are certain advantages in favor of the latter country. It is an insular one, with a strong navy, consequently safe from conquest.

There is a system of police protective tariff in the city of New York, terms on which unlawful business can be carried on. It is the Tammany scale, or a tariff within a tariff, so to speak. Disorderly houses are assessed \$500 specific duty, and \$50 to \$100 per month advalorem. Unlicensed concert saloons from \$50 to \$250 per month advalorem. Green goods men (counterfeiters) according to the number of "turning joints," whatever these are, come in for \$1,000 a month. Police appointments are charged at \$300 to \$400; a sergeant's place \$3,000, and a captain's commission is worth \$10,000 to \$17,000. This is what Mr. John B. Leavitt says in the *Forum* for August. The amount of money thus collected has been estimated as equal to the taxes paid in New York. In reading, one is reminded of Mr. Nelson's assertion, elsewhere noticed, in respect to official corruption, and wonders where he can find a parallel for this.

Those who argue that combinations and trusts are necessary to the development of industry and progress can perhaps explain how the makers of steam engines, also machine-tool and locomotive makers, manage without such organizations. There is hardly another branch of skilled manufacture so extensive as the making of engines,

and few larger than iron and wood-working machine making, but there are no combinations, and none thought of so far as we know. Competition is open, but prices are satisfactory in all cases where the skill is equal to competition. One reason why no combinations exist is the want of uniformity in the products. If steam engines and machine tools were made alike everywhere, so a stock could be accumulated for future sales, and orders supplied from various sources, then a trust could be formed and prices be regulated by a "board." As this is not possible these industries have to submit to the exactions of others, but a turning may come in time, when all these things will be "evened up."

The depravity of our age, and its cruel selfishness, is shown in the wish frequently expressed that China and Japan will continue their war, so as to draw supplies from this country. Such a sentiment is pure savagery. No one can derive permanent benefit from a destruction of property and life in Asia, or elsewhere, but this is not the main point. People who can get into that frame of mind that permits them to wish for the murder of other people as a means of commercial gain to themselves are people well to avoid. Very little added to such a spirit includes a desire to destroy one's own neighbors in the same interest. The struggle for wickedly-gathered wealth is just now the great and primarily the sole cause of the disorder and crime that afflicts people, and the above referred to sentiment is the essence of all.

Utah and New Mexico are applicants for admission as States, and have been for a long time in the past. The main consideration in determining this matter in Congress seems to be what the politics of new Senators and Congressmen will be in case these territories become States. We have seen no comments in the matter in which this subject of politics was not brought in, and foremost. Utah polled in the last general election 31,000 votes, and New Mexico 34,000, showing ample population. There are many important considerations to be taken into account in admitting these new States, but of these we hear but little, the main thing being will new States send Democrats or Republicans to Congress? To what an estate have we fallen! There is no one, it seems, outside the plane of political expediency, to think, speak and act for the country as a whole.

The Berlin Iron Bridge Company, a large iron works in Connecticut, have increased the wages paid in their works ten per cent. on condition that the men produce that much more. This is a common-sense scheme, much better than "profit sharing," and is equivalent to the owners saying to the workmen, if you will add ten per cent. to production in your department we will give you the greater share of this increase. The concession would amount to at least three quarters of the ten per cent, or seven and one half per cent. The increment in production of ten per cent. would not be chargeable with expense, maintenance, superintendence, and so on, the owners will gain about twenty-five per cent., and the men, as before said, about seventy-five per cent., which is certainly fair to the men if not to the company. It is paying to the men a definite amount, ascertainable by them, in return for another definite amount they create, and will succeed.

The New York *Nation*, a journal by common consent a foremost one in this country dealing with matters political, comes to hand with fierce denouncement of the lawlessness and disorder of our time. This no one can find fault with, but in a journal of that class one naturally looks for some theory of the cause of unrest, strikes and violence. When a house is burning down it is the duty of all to join in an attempt to put out the fire, and to urge the supremacy of the law at this time calls for no more than common sense and reasonable patriotism, but when the fire is over, and when the powers of the law have quenched the physical disturbances, then comes the question of causes. How did the fire occur, and who caused the disturbance now abroad in the land? On this latter point the *Nation* is silent. It would be a pleasure to know what the editor's opinion is. Whether the strikes and disorder of our time are due to the wickedness and ignorance of the disaffected, or is there some active cause that incites men to throw away their bread

The Chilian Government is in many respects a paternal one, and may be so without incurring the usual penalties of that policy. The Government itself is usually composed of able and patriotic men far in advance of the people. The country is small, homogeneous and ambitious. The latest movement of industrial importance there is a proposal to give the sum of \$600,000 in premiums for the establish-

ment of various manufactures ; for example, \$50,000 each to a cotton mill, linen mill, glass works, earthenware and bag factory, with smaller sums to other industries, in all ten. What this will amount to remains to be seen. It is a good time to invite such industries. Countries where by over stimulation, as in our own for example, can well spare the implements, labor and skill for transplanting to Chili. Such industries, unless founded upon natural resources and predisposition of the people, will last about as long as the Government subvention does. If the tax is shifted to the consumer by a tariff it is the same thing, but less fairly distributed than by a direct premium, as in the present case.

The debt of the Australian Colonies is, in all, about 965 millions of dollars, or in amount more than one third that of England, and per head of population three times as much, but this debt is not for money wasted in war. There have been 12,500 miles of railway, worth 600 millions, built with this money. They have also the telegraph lines, 46,000 miles, and large irrigation works on government lands, with other property, that in the aggregate will very nearly offset the enormous debt, one such as the world has never seen before. New Zealand increased her debt in ten years, from 1881 to 1891, 27 per cent., while the other colonies averaged an increase of 160 per cent. during the same period. Under the new regime in New Zealand, which we may call the "populist" one, no borrowing is permitted, so the circumstances are different in an astonishing degree. England has a vast interest in Australia. Private investments, with the public borrowing, will, no doubt, exceed \$1,200,000,000.

ENGINEERING NOTES.

Mr. Charles Brown, of Basel, Switzerland, whom we quote elsewhere, in respect to storage batteries, is now engaged in making some street railway cars in a form that should command the attention of people in this country. Aside from various details relating to propulsion and construction, the system consists essentially in mounting each wheel independently, or pairs of wheels together at the sides of the cars without cross axles, and thereby avoiding the slip that occurs on curves when the wheels are keyed on cross axles in the usual way. The amount of loss in slipping the wheels to com-

pensate for the difference of arc in the two rails when passing curves is not much considered, but is quite enough to engage attention when traction is expensive. An examination of the drawings in Mr. Brown's patent specification discloses that the details are not increased by his independent wheel method, and that for electric traction there is in some respects peculiar adaptation of his system. He will no doubt furnish information to any of the car builders in this country who will address him as above.

There was held at Paris, in July, a trial of self-propelled vehicles, operated by gas, steam, electricity and by hand, to run in competition over a course of more than 150 miles. There were 102 entries from 93 different firms and companies, nearly all French, and nearly all in Paris. There were two from Germany and one from England, the latter being withdrawn. The speed is limited by law to 12 kilometers or 7.44 miles in towns, and 20 kilometers or 12.4 miles an hour in the country. There was a preliminary trial to weed out incapable machines, none being permitted to contend in the final great race unless filling the conditions of the preliminary trial. This is a wonderful matter, perhaps the precursor of something like the velocipede craze. It will be different however in respect to being confined to the rich, because one of these carriages, judging from drawings of them, must cost from \$2,000 and upwards, hence will be a matter of little concern to journalists at least.

Some time ago, we do not remember when, there was a short dissertation in this Journal on horse power, not the unit of work, but the work of a horse, and it was assumed that the kinetic or dynamic feature of this kind of a motor, was in the fact of a horse being able to exert for a moment, or without stepping, about ten times his average draught power, and for some distance five times as much. Confirmation of this is now seen in the fact that a street railway carriage, such as two horses will draw, when equipped with electro motive apparatus requires 10 to 12 horse power. This wide margin is to overcome inertia of the car at starting, and to climb grades, where a horse as before said, will exert five times his average draught power. The inference is that we can not make machinery adaptable to wide ranges of work, as well as nature can.

The cost of a horse power generated by a steam engine, has been a fruitful topic for some time past, and seems to have settled down to a kind of standard now in which a triple expanding engine is expected to furnish one horse power for one year of 308 days for \$31, when coal is \$2 per ton, and for \$37 when coal is \$5 per ton. Intermediate prices for coal varying the cost of a horse power between those limits. This is for engines of more than 50 horse power and of good construction. The very highest class of modern mill engines run the amounts down to \$17 and \$24 but there are only a few in this class. Condensing engines are now rated at \$50, for coal at \$2, and \$62 with coal at \$5 per ton of 2,240 pounds. From an average of the whole one may see that the average cost of steam power is about \$50 a year for each horse power, when the amount generated exceeds 50 horse power.

“An English engineer in Germany,” writes a letter to *Engineering* in respect to the explosion of a steam pipe on the German war-steamer *Brandenberg*, and if his surmises are correct there is no reason why the pipe should not give way. It was a copper pipe, ten inches in diameter, turned at a right angle, and the short leg inserted in a stuffing box held only by the packing. This at modern steam pressures would cause a direct transverse strain on the end of the long leg of three to five tons, and rupture any pipe. It is in fact the same thing as bolting a section of pipe with its flanges against a wall, and hanging this much weight on the outer end. A stuffing box breaks the continuity of a pipe, cuts it in two, one may say, and if no provision is made to compensate the lineal stress due to internal pressure any pipe will break. If this construction was adopted it was most stupid.

The iron light tower, which we some time ago gave some description of, has been completed, and drawings of it published in *Engineering*, London. The structure is 175 feet high to the lights, and from an examination of the plans one must conclude that for anything that appears there should be no more lighthouses built of masonry. There is a central tube of riveted plates in which there is an elevator and stairway. Stability is given to this tube by an inclined open framing of very symmetrical appearance, and, no doubt, of much less cost than the same strength could be provided for in masonry. Captain Mahan, Engineer to the U. S. Lighthouse

Board, furnishes a table showing the calculations for stability, in which we note there is provided factors of safety of five to six, and in the case of wrought iron members one eighth inches in diameter extra for corrosion. The tower has been erected at Cape Charles, coast of Virginia.

The enormous gain of efficiency in pumping engines during twenty years past, is indicated by the town of Reading, Pa., now asking for tenders for a service engine, that will give a duty of "110 millions foot pounds to 100 pounds of coal," also stipulations for the tensile strength of all material used, both cast and forged. The standard of efficiency assumed, and it is a good rule to remember, is :

$$\frac{P \times N \times H \times 100}{W}$$

P = pounds of water per stroke of the pumps, N = number of strokes, H = total fluid resistance, the latter is in pounds per inch. In the case of the Reading pumps the head will be 208 feet, the estimated friction head 79.66 feet, or a total of 287.66 feet, and an addition is made for roughness to bring the total resistance to 300 feet of head. Boiler pressure is limited to 90 pounds. Reading is a scholarly place, also one where there is much skill, and contractors will do well to be careful in tendering there.

Prof. R. H. Thurston, in various writings of his on the subjects of friction and lubricants during ten years, has adduced much carefully observed data, which goes to show that friction is an inconstant condition that does not admit of exact expression, consequently there is no such thing as a "law of friction." We have just looked over some of those propositions laid down by Prof. Thurston, at and since 1879, and much wonder that he has not in addition to his valuable contributions on these subjects, cautioned people against the set rules popularly believed and accepted, as "laws of friction." Of course machine friction must be considered in connection with lubrication, and if even the resistances were constant, no measure or coefficient would have practical value unless considered in such connection. There would be no value in rules to determine dry frictional resistance, or at least there would be but little value, because dry surfaces are not dealt with in the moving parts of machines or structures.

Mr. J. A. Normand, in *Engineering*, contributes a long article fortified by formulæ to prove that the flow of water into a vacuum formed behind propeller vanes, is in proportion to the square root of the depth of emersion, also made experiments to prove this proposition, and speaks of the rupture of the water in front of the vanes, all of which relates to propellers not in progression through the water, and has consequently not much to do with their operation. Making all due allowances for slip, which is accountable for without "a vacuum behind the vanes," we think Mr. Normand will find if it is possible to prove it by experiment that there is no vacuum or free space behind the vanes of a propeller when it is progressing normally through the water, and that it acts like a screw in a nearly solid nut. The progression into still water even at moderate speed furnishes a stability by inertia that will not call for or permit a vacuum behind the vanes.

There has at various times arisen controversy over fluid steps for vertical shafts to sustain their weight, also to resist thrust upon horizontal shafts. The device is very simple, consisting of an open end cylinder into which the end of the shaft projects, a stuffing box and gland or cup collars around the shaft to prevent the escape of the fluid, and some means of forcing in a supply of oil or water. Some trouble might be saved if the inventors of these hydraulic steps knew that this method of supporting thrust was employed by the celebrated Joseph Bramah, and particularly described in his patent No. 2652 of 1802. He not only invented the hydraulic step, but went farther by using the fluid as a means of vertical adjustment for the spindles of his wood planing machines. A small pump was employed to draw out or force in the fluid, as the spindle or shaft required to be set up or down. The description is too long to be quoted from here, but anyone interested will find the whole matter fully described in the patent above named.

Mr. Maxim has at last, after four years of work, started a flying machine that exerted a lifting force of from 4,000 to 8,500 pounds, and actually flew in the air. On two trials, with 150 and 240 pounds of steam pressure, the machine soared a distance of 1,700 feet, when it fell, because it lifted a guard rail provided to keep the machine from rising too high, and capsized. The propelling screws are 17 feet 6 inches diameter, revolve at 400 revolution per minute,

and develop a thrust of 2,000 pounds. The machine carries compound engines, a boiler of 300 horse power weighing only 1,200 pounds. The aeroplane has a surface of 1,400 feet. It is 50 feet wide, and beyond this are wings each 38 feet long, so the whole width is 136 feet across; a fearful-looking thing it must be. What it is for, is hard to imagine, there is neither need of nor use for such a thing, and the presumption is that Mr. Maxim is trying to show his skill as a contriver of the peculiar mechanism employed.

Last month we alluded in a facetious way to a "water plane" in connection with thirty-knot torpedo boats, and since then have concluded that there is more fact than fancy in this matter. If a vessel can be raised out of the water by her propelling power to skim the surface as an aeroplane does in the air, then the limit of speed will lie, as it does in aerial machines, between the power and weight of the propelling apparatus. Contracts are now let for boats to be propelled at $34\frac{1}{2}$ miles an hour. Normand & Co., of Havre, France, have such a contract, and there are some contracts in England nearly the same. There is no sign there that this is a limit, except in a commercial way. The proper place for high-speed experiments is in rivers, or on smooth water, but in that case a railway along the bank would have the advantage of less resistance. Broadly stated, modern tendency is to run over the top of the water instead of waiting for it to be divided by a vessel and then flow back around the stern.

Mr. William Cox, C. E., Editor of the *Compass*, who has contrived several ingenious methods of computation by means of mechanical scales and apparatus, some of which we have illustrated in previous numbers, has added another one for computing the flow of gas in pipes. These instruments, invented by Mr. Cox, are of great utility, not only in respect to the saving of time over ordinary methods, but in the assurance of correct results. Besides, computations made by hand, so to speak, always involve more or less counter calculation to check and prove results. The common formula for the flow of gases in pipes is

$$Q = 1,000 \sqrt{\frac{D^5 H}{G L}}$$

Q being cubic feet per hour; D , diameter of the pipe in inches; H , pressure in inches of water; G , specific gravity of the gas, and L

length of the pipe in yards. From this it may be seen that computation is tedious. In Mr. Cox's instrument these factors, or their values, are arranged in circular scales, adjustable relatively, so that any problem of quantity, or dimensions of pipes, is solved at once without chance of mistake. The instruments cost ten dollars, and can be procured from Mr. Cox, at Stapleton, New York.

The Otto Gas Engine Company, at Philadelphia, about two years ago, fitted up a gas engine plant of three hundred horse power to operate a lighting station in Danbury, Connecticut, that has ever since gone on quietly and successfully performing the work. There are three double-cylinder engines of fourteen inches bore that run at a speed of one hundred and sixty-five revolutions per minute. This plant, it seems, was put in to take the place of a steam one, and if so it is a significant fact. Most people wonder at the slow progress of gas engines toward large powers, but it is quite fast enough. The circumstances change as engines grow larger. It is not a problem of piston area, and connections to match, as in the case of steam engines. There are a good many other things to be watched, and impediments to overcome, but there is all the time progression, and every step gained is held. The manufacture all over the world has been in the hands of able and conservative men, some of them among the most eminent mechanics of our time.

ELECTRICITY.

NOTES.

Professor Gray, of New York, has been experimenting in London with his "teautograph," by means of which written telegraph messages are sent in photograph, so to speak, that is, the original is reproduced at the other end of the line *en facsimile*. A correspondent writing to the *Times* about the matter, claims that the electric "copying telegraph" was invented forty years ago, and messages were sent in this manner between London and Brighton, also that the copying telegraph was exhibited at the first world's exhibition in London, 1851, receiving the highest award there, and further, that Mr. A. E. Cowper had invented and exhibited a writing telegraph. These facts, if substantiated, will interfere with any patent claims that Professor Gray may have, unless as to method, and his method is, no doubt, different from those in the above cases.

We are much given to high speed in this country. High speed engines, boilers, dynamos, and according to Mr. W. W. Griscom, Philadelphia, high speed electric storage batteries. The following is from some recent remarks of his on this subject :

"Why is cautious, conservative Europe so far ahead? Why is America a laggard in the running? The answer is not far to seek. Storage batteries are always an economical success abroad, while here they have been too often an economical failure in the past. And the reason is that the European always demands a margin for safety, while the American, with less capital and keener competition, is tempted to sail too close to the wind. A storage battery continually worked to its commercial rating is a commercial failure. A storage battery worked sufficiently within its capacity is invariably a commercial success."

The nature of electric welding of metal was well explained recently, by Mr. B. A. Dobson, C. E. in a lecture as follows :

"Every substance, whatsoever be its physical nature, is heated when traversed by an electric current; and the law defining the quantity of heat so produced is as precise and as clearly ascertained as is that of gravitation. The product $C^2 R$ —that is, the square of the current flowing, multiplied by the electrical resistance of any considered portion of the circuit—is directly proportional to the heat units therein produced. For a continuous current, the resistance of an infinitesimal length of any conductor is inversely proportional to the area of its cross-section, and in metals increases with increase of temperature. Thus in iron the resistance increases some tenfold with a rise of temperature from 0 deg. to 1,000 deg. Cent. For alternating currents, which are usually employed in welding, the resistance of a conductor no longer varies inversely as its cross-section; but this divergence may be neglected without error in the description of the process, if not in the design of the welding machine."

A Mr. Morris, at Birmingham, England, has troubled himself to invent a combined volt-meter and am-meter to measure electric currents, producing a neat instrument, but subject, as we imagine, to the same objections that apply to combination machines. Going back twenty-five years, and before the division of labor and organization of processes had made so much progress as now, a good share of inventing and contriving was directed to producing implements and instruments to perform two or more functions. There was, it is true, the advantage that such combinations admitted of a second invention, to separate them again, so that each would perform a single work or function. We imagine that electricians will prefer a separate instrument to measure volts and amperes.

MINING.

NOTES.

There may be some good reason for sinking shafts instead of boring holes for prospecting purposes on this Coast, but such reason is not apparent. Of course a prospector, or an owner even, is not expected to put down bore holes. It is an operation requiring special experience and plant that cannot be afforded for one hole, or for several holes, but a firm or company that would undertake such work by contract should succeed and save a great deal of money. In the eastern country holes are made by companies that contract at a price per foot in various kinds of material, furnishing samples all the way and determining the formation, just the same as though a shaft were sunk in the same place. Diamond-core augers are employed, and the machinery is quite complex, or would be to the unskilled. The Derbec Mining Company are now boring some prospecting holes.

The Broken Hill Mines, in Australia, that were a short time ago in a state of collapse in so far as the value of shares, will, no doubt, soon recover, if not exceed, the old rating. A recent run of one week produced \$533,000. A yield at the rate of six millions annually is pretty strong mining, but, as the *Engineer and Mining Journal* explains, the week's run above named included a clean-up of by-products for six months preceeding. These mines, which are almost by accident in New South Wales, being near the line of South Australia, constitute a large part of the mining interest of the older colony. A recent election has condemned the import taxes or tariff system in that colony, instituted about ten years ago in a modified way, and the future will see, no doubt, a renewal of prosperity that characterized the colony down to that time. A tariff system does not help mining interests.

It is proposed to hold at Sydney, New South Wales, an exhibition of gold-extracting appliances, including crushing machines, and a lively contest can be expected between the various crushers, concentrators, processes, and so on. There is an exhibition building suitable, and all things are propitious for such a show. It will attract

much interest everywhere, and we venture to offer a suggestion to Mr. W. A. MacArthur, the manager, or the committee in charge. This one: Make no awards or prizes. This system, born of the days of chivalry, and always the cause of dissension, and nearly always unfair, can well be eliminated in a country to which the world is apt to look for new ideas. If the authorities will watch, compile and confirm results, that is quite enough, let the exhibitors manage the rest. Each will, according to the merits of his exhibit, share in the advantages of exhibiting, and the whole affair be raised above the plane of favoritism.

The *New York Sun* is credited with an account of Mr. Edison's magnetic ore-separating scheme in New Jersey, and gives an account of an interview with him at the mine in Morris County, where Mr. Edison said his mill would "crush five hundred tons a day, and was bigger than all the gold ore-crushing mills in the country put together." If Mr. Edison said any such thing, and it is possible, he is better informed on electrical apparatus than on ore-crushing machinery. There is one mill on this Coast that crushes six hundred tons a day continually, and has for years. Another cipher added to Mr. Edison's estimate would still leave it short of the fact. The mill we allude to is the Treadwell, on Douglas Island, Southern Alaska. There are plenty of one hundred-ton mills besides, and the aggregate of quartz crushed must be, as said, nearer five thousand than five hundred tons a day. Mr. Edison's scheme is to extract iron magnetically from ore bearing twenty per cent. of metal, and will, most likely, be a failure.

English capital has, within a month past, been looking up mining properties, and for a wonder too, when one considers the present disclosures respecting the Harney Peak tin mines, and the swindle perpetrated there. It is time that foreign investors learned a good deal about the ways of these mine-sale promoters. The sale of the Emma mine, in which Minister Schenck was interested, nearly twenty years ago, was one of the first cases. Since then they have followed with tolerable regularity. The difficulty of foreign investors in our mines is in securing safe advisors here, and it is sometimes said there is no one to be trusted, but this is not true. There are plenty of men who will honestly estimate and report upon

mines, but they are not of the advertising kind, and are not found, frequently are not wanted. The fact is, mines, like almost everything else, are falling into modern trade methods, and the rule for purchase is *caveat emptor*.

The MacArthur-Forrest cyanide process for extracting gold is at last fairly on trial as to the novelty of the invention, by a suit now in progress in London. A new company, the "Cyanide Gold Recovery Company," an organization that is operating under a pending patent, which is opposed by the MacArthur-Forrest Co., are complainants. They employ an electric current in their process, which the learned judge has from sufficient evidence informed them was "of no use," and the issue is narrowed down to the novelty of the old patent, with a strong prospect that its scope will be confined to zinc shavings as a base of deposition. This may be quite enough if there is no other sufficient way of "catching" the gold. It is a very important suit every way, and will especially effect the South African mines, where the cyanide process is most extensively employed.

Nickel is a valuable metal, dear in price and of course scarce in proportion. Heretofore nickel mines have been few and far between. A New Jersey one that enjoyed the advantages of a Government tariff job some years ago is the principle one in this country. The Sudbury mines in Canada are principal on this continent, but the supply is only a fraction of what is needed for plating and other purposes. The news from New Caledonia, off Queensland, Australia, is that discoveries there will soon furnish a full supply of this useful metal. The Belgian consul at Noumea reports to his government that in the French penal colony, New Caledonia, nickel has been found over an area of 30,000 square miles, and that one tenth of this area has been taken up as mining lands. There is no arsenic in the metal, and the ores yield 8 to 10 per cent. The export of ore reached 5,000 tons in 1890, and is now much more. Convict labor is employed to a great extent.

MISCELLANEOUS NOTES.

One storm in New York, in February last, cost the city over \$30,000 for carting away the snow. There were nearly 60,000 cart-loads, which shows a cost of 50 cents a load, but the expense in all is given at 58 cents a load. Only a part of the snow was removed, about one fiftieth of it. There was a snow storm in London that cost \$10,000 to cart away. There is something remarkable in this; snow is not common there, but when it does come business is in a great measure suspended. It mixes with the soot and grime of the streets, and makes a villianous compound. The absence of snow and frost here in San Francisco is a blessing that people cannot well realize until they happen to endure it elsewhere, but people are as a rule oblivious to their environment. When we were in Winnepeg, some years ago, the host at a hotel where we stayed said: "We are having fine weather. For a month the thermometer has not been below zero, and is two or three degrees above now." We thought of no suitable answer to this remark.

The following extract is from a recent communication to the State Department at Washington, by U. S. Consul Meeker, at Bradford, England:

"As a general thing the prices of all grades of American wool are now practically the same as the similar grades here, the carriage and other charges between the American port and Bradford making most of the difference against the American article. The wool merchants and manufacturers here assert that the moment the Tariff Bill passes, with free wool, the prices of American wool will revive, and several of them are so strong in this faith that they have, through agents, made large investments in wool now held in Philadelphia and Boston. They insist that the new impetus given to manufactures by free raw material will cause larger quantities of the wool produced in the United States to be mixed with fine foreign wools, and that a demand for American wool for hosiery purposes would immediately set in on this side. It is already proposed by wool dealers here to exchange the grades of wool more suitable for dress goods and cloths for the American wool adapted for hosiery and other purposes. They argue that this will at once bring about renewed life and activity in the trade and raise prices."

"INDUSTRY."

JOHN RICHARDS, EDITOR.

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THE RELATION OF RAILROAD TRANSPORTATION TO PRODUCTION IN CALIFORNIA.*

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✓ In the Sacramento *Record-Union* of March 11th, 1892, appeared a paper entitled "California Landholdings," written by Mr. W. H. Mills, who is a prominent official of the Southern Pacific Company. Though in it there is no reference to railroads or to railroad transportation in California, singularly enough, and probably unintentionally, it is specially of value as it throws light on railroads and railroad transportation in California. Surprisingly, because written by a Southern Pacific official, it is the most complete and correct statement of the results of the Southern Pacific Company's business policy that has yet appeared in print, and more conclusive and impressive in this year of 1894 than when written in 1892.

It is only fair to state that the writer seems to have been utterly unconscious of a possible significance of his elaborately gathered facts and statistics other than that presented by him. That they have a definite relation to the Southern Pacific Company's rates of

*A paper read before the Technical Society of the Pacific Coast, September 7th, 1894. Published by permission of the Secretary and Executive Committee.

fare and freight, is recognized by Colonel R. S. Morgan in his report to the Railroad Commissioners, Messrs. Beckman, Rea, and Litchfield, in 1892, in which report he embodies a portion of Mr. Mills' paper as an exhibit, and in his argument uses the facts it states as a reason why the rates of fare and freight should not be reduced but must be maintained.

Mr. Mills in his paper, by compilations of statistical figures taken from the census of population, shows a decrease in population of certain of the agricultural sections of the State, and by another set of statistical figures taken from the county assessment rolls, establishes as the cause of this decrease of population, the increase of large landholdings through the consolidation of small landholdings. Had the statistical figures of the freight and passenger traffic of the Southern Pacific Company for the same time and territory been given, the paper would have had the value of completeness as well as correctness. Apparently, however, Mr. Mills, if he had these last statistics in mind at all in preparing his paper, considered them only as expressing one of the unfortunate effects of the decrease of population and of the increase of the monopoly of the land, and therefore not relevant, either to the consideration of the cause of that decrease of population and increase of land monopoly, or to the remedies desirably to be applied.

Mr. Mills states as a conclusion from his statistical figures and general argument, that the land monopoly developing in California is in the highest degree prejudicial to the best interests of society and the State, in that it is not only decreasing population and wealth, but is sapping at the very foundations of our political institutions. Realizing the necessity of society and the State destroying land monopoly before land monopoly destroys society and the State, he proposes certain legislation as the justifiable and desirable corrective to be applied. Considering the cause of land monopoly in California to be the rapid accumulation of wealth, that seeks investment in land largely for the security alone, and the facility with which land can be made the pledge for borrowed money, his proposed legislation would make: first, the use of land as security for debt practically impossible; second, the future accumulation of wealth in land illegal; and third, would force the distribution of land already so accumulated by prohibiting its succession by will. Questioning all of this proposed legislation, I realize that a discussion of it is profitless except as the statement of fact on which it is based is correct.

Is the cause of land monopoly in California what Mr. Mills states it is, or is there some other cause? Or stating the question in another form: are Col. Morgan and the Railroad Commissioners right in saying that the decreasing population and increasing land monopoly justify the rates of freight and fare imposed by the Southern Pacific Company, or are they wrong? Are decreasing population and increasing land monopoly the causes of the condition of fares and freights, or is not the fact that the condition of fares and freights is the cause of decreasing population and increasing land monopoly?

Mr. Mills emphasizes the undesirable social condition forced on the small landholder as being the cause that eventually displaces him to increase the monopoly of the land. This small landholder, he very truly says, is deprived of opportunities of education and society for himself and his children, and must live a socially unpleasant isolated life. This social condition however, is itself an effect of the real underlying cause, which is the undesirable business condition of his small landholding. It does not pay. And it is because small landholding has become more and more unprofitable that it has become undesirable and has been given up, schools and churches disappearing with it. Anywhere in the State where small landholders are engaged in general farming and the production of the staples the same story will be told. Farming does not pay, and the small landholder is anxious to sell. For this condition of not paying there are several causes, some generally known and recognized and others not. There is no question but that the great plains of the Sacramento and San Joaquin Valley no longer yield as much wheat to the acre as fifteen years since, and their production of wool, hide and meat is less in even greater ratio. There is no longer a relatively large local market of people who are not producers of agricultural commodities, the mining communities of this State and Nevada, and the local market that remains is partially supplied with the surplus of outside points of production. All staple agricultural products are lower in sale value in the outside markets of the world through the competition of cheaper areas of production. General business conditions have so changed that quality being the same, the large producer has invariably the advantage of the market over the small producer. Where the small producer has to accept in transportation the general tariff of the railroad, the large producer can frequently get special rates. Car, storage and shipping facilities are given to the large producers, that the small one must pay for

and sometimes cannot get by paying for. The difference of rates between carloads and fractional carloads is to the constant business disadvantage of the small producer. The large producer gets free transportation frequently, the small one never. Most serious of all, the rates of transportation for the distinctively small farm products, butter, eggs, poultry, vegetables and fruit, which bring higher prices per unit than the staples, are such that so far as the producer is concerned they are no more profitable. The extent and value of farm improvements averaged to the acre of farm, are as a rule, inversely proportional to the total of the acreage. Small farms have several times the amount to the acre that the large farms have. Personal property appurtenant to the farms has the same acre relation. The acre of the small farm is thus burdened with a heavier flat investment than the acre of the large farm, and is taxed annually on that excess of burden.

The direct tax on land determined by its acre assessment can be made, and is more often than otherwise made to favor the large landholder. Each acre of the small landholding has absolutely a larger burden of capitation taxes, poll, than the acre of the large landholding, and absolutely a larger voluntary tax for the support of churches and semi-public institutions, and for fees and charges to public officers. The direct farm cost of production of staples is less per unit on a large landholding than on a small one simply because the labor is cheaper.

No one of the preceeding differences is very many dollars in itself, or very many cents in acre charge, but the aggregate of them all is large. It is distinctly to the disadvantage of the small landholder. Comparing the acre cost of production, taking all these items into account, there is a much smaller margin of acre profit for the small landholding than for the large landholding. And it is possible for a depression of sale values permanently, or for a temporary fluctuation even, to wipe out entirely the margin of acre profit for the small landholding, and still leave a margin of acre profit for the large landholding. This in fact is exactly what has been happening during the last fifteen years. The margin of profit for the acre in small landholdings has become entirely wiped out or so nearly so that the farming of small landholdings has become surely unprofitable, and as a logical and business necessity they have become undesirable. The margin of profit for the acre of large landholdings has been materially cut down, but the large landholders have maintained or tried to maintain their aggregate net

income by increasing the number of acres from which to draw it.

It is this last tendency that Mr. Mills has observed in the statistics and which, utterly out of touch with the men who own and work, he calls the desire to own land for its security as an investment and as a basis for loans. In reality the tendency is the expression of the instinct of self-preservation, the desire to survive by the line of least resistance against conditions becoming more and more adverse. That this tendency persists is due to the fact that the larger landholdings have or have had surplus incomes that can be applied to increase acreage even when the small farm becomes unprofitable. The small farm, unprofitable by itself, becomes profitable as part of the large farm simply because the load of its occupancy by the small landholder is taken off.

The primary incentive to the acquirement of wild land is the anticipation of profit through a rise in value, this rise in value being what is termed the unearned increment. It is the increase due to the development or anticipated development of the earning power in excess of current interest on the primary investment, being the capitalization of that excess of income at current interest. In farming lands the amount of this increase is of necessity dependent on the character of culture and improvement possible and on location with reference to centers of trade and population and channels of communication. Soil and climate determine the most desirable kind of product for the land, and on its mean annual profit is established its basis of value. Here in California the product has been wheat. An examination of land values anywhere in the wheat growing sections will show them based almost exclusively on the acre product of wheat, and except in isolated districts entirely independent of the cost of transportation or distance from centers of trade and population. The values thus determined twenty and more years ago have been fairly constant as the rate of current interest has been steadily decreasing, and as fluctuations in the sale value of wheat were practically compensated to the producer by the flexibility of the freight rates to the markets of Europe. The primary purchase price per acre being very small, wheat productions gave incomes that were interest on sums several times the flat investment. It was not uncommon for the first crop to pay back the cost of land and of all the improvements.

The minor farm products having the local market free from the competition of the surplus production of the East were also very profitable. The limit of value for these lands was rapidly reached

and for many years past their desirability came to depend wholly on the amount and certainty of their net income producing power. This however instead of remaining constant has decreased so much that the consolidation of the small farms with the adjacent large ones has been forced. The decreasing current interest rate, by maintaining the exchange value of the land, has operated to conceal the cause. So too has the anticipation of the development of an increased earning power through a change of production. The business results of farm culture during 1893 and 1894 have swept away illusions, and the cause of our permanent industrial and business depression is clearly in evidence. Land monopoly and decreasing population are simply effects, the ultimate and worst effects, of the cause of that industrial and business depression.

It is people who make a country. It is the possibility and profit of production that attracts people. That kind of production which attracts and supports the largest number of people is the most desirable. Wealth is the net gain of production over consumption, established into relatively imperishable but convertible products or natural things. No kind of production which will not give a net gain over its consumption, which will not produce wealth, will attract people. It will not make a country. Mr. Mills' paper on "Large Landholdings" is the first published recognition by any official of the Southern Pacific Company, that the net gain of production over its consumption is disappearing for California producers; that their lands under present conditions are not wealth creating; that they no longer attract people; that, in fact, people are leaving them.

Mr. Mills finds population decreasing, and with it the acre production of the land. He finds acre railroad earnings are decreasing, and has made a partial discovery of the relation between population, acre production, and acre railroad earnings. In a published letter to Mr. Huntington he makes public the fact that wheat gives only a sixth of a ton of freight to the acre, and a short haul at a low rate; whereas fruit, another product of the soil, gives a car load of freight to the acre, and a long haul at a high rate. Though he does not state it, it is an obvious conclusion that the exchange commodities for these products have a like ratio of earning to the railroad, and with passenger traffic the ratio is even greater.

Mr. Mills clearly sees that conditions so disastrous to the best interests of society and the well being of the State — and to the rail-

road—must be changed. He clearly sees that more people and smaller landholdings will accomplish the desired change.

As a means of getting more people in the country, and inducing them to cultivate the soil, the simple cutting up and sale of the large landholdings is no inducement, and cannot be a success. As a matter of fact the small tracts can be had now, but the desire to get them does not exist to any marked degree. Small landholding must first be made safely profitable before it can be considered desirable. To be made safely profitable the economy of production must be changed in the direction of materially cheaper cost to the producer.

The sale value of our great staple, wheat, is not determined by the production of California, but by the demand in Liverpool, and the sale value is fixed there. The sale value at the point of export in California, tide water in the Bay of San Francisco, is the Liverpool value less freight, interest and insurance. It is with this sale value at point of export that the California producer is concerned, and with the items and amount of the cost of production to that point. These items of cost of production are, first, the farm cost, which on the authority of the State Board of Agriculture is half a cent a pound under conditions of large acre yield on the very largest landholdings, and which is certainly three fourths of a cent under the average conditions of acre yield and area of land ownership; and second, the freight and incidental charges of transportation.

The first of these items, the farm cost, cannot be lessened, if anything economy has gone too far in the attempt. If the cost of production is to be lessened it must be in the second item, the freight, more specifically the railroad freight wherever the railroad is a carrier. As sale values are at the present time the railroad freight takes a portion amounting to a third, and more from wheat produced in the upper San Joaquin Valley. So much in fact that the sale value does not even recoup to the producer his farm cost alone, and for the use of the land it pays nothing. If small landholding is to be made safely profitable, small farm products must have the advantage in the local markets, which their nearness legitimately entitles them to. This advantage can be assured if transportation charges be made on the basis of the service rendered only. The present condition is such that the Eastern producer is admitted to the market on more favorable terms as to freight charges than the local producer. If small landholding is to be made safely profitable railroad transportation charges must not discriminate between classes

of production. Also must the transportation of products, as between large and small producers, be placed on an exact equality. Finally, such transportation rates should be made on the distinctively small landholding products exported from the State as to insure a profit to the producer despite the ordinary fluctuations and uncertainties of the market. To illustrate this last take the case of a 25-pound box of green peaches (of Placer County), a distinctively small farm product. The cost of production to the point of consumption is made up of the following items:

1. The farm cost, cultivation, pruning, picking fruit, packing, and transportation to the railroad station.....	\$0.135
2. Water for irrigation.....	.01
3. Box.....	.07
4. Paper for wrapping.....	.01
5. Putting into car.....	.025
6. Railroad freight, including ventilator car (if with refrigerator car \$0.156 additional).....	.47
7. Selling commission, 7 per cent.....	.05

Total cost of production at consuming point..... \$0.77

That is, the box of peaches must sell for 77 cents to just repay all the cost of production. If more than 77 cents is received, 93 per cent. of the extra amount is profit, which is the earning of the capital invested in the land and trees. This extra amount is now so small that a slight depression in the market sale value, or a slight impairment of quality incident to the long transportation, makes the fruit produce a loss to the grower. A margin over the cost of production of 15 cents (which is more than the average for the last two years) on a production of 500 boxes to the acre for 10 acres amounts to \$750. In addition to this, \$0.135 a box, \$675 for 10 acres, the farm cost of production, comes back in the sales return. Of this last amount \$150 will be the cost of keeping a horse, and \$250 wages and board of extra labor, picking and packing, leaving \$275 for the wages of the owner. This, added to the \$750, makes a total net return to the grower of \$1,025 per annum.

The same mechanical skill and intelligence required for the successful growing of fruit would bring to its possessor as wages, without capital investment, in other forms of industry not less than \$3 a day, amounting to \$900 per annum. The difference between this amount and \$1,025, \$125, is in reality the total gross income of his capital of land and trees, from which must still be deducted taxes and other charges incident to the possession of property, leaving certainly not more than \$100 as the net income of his investment of

10 acres of land and orchard. The ultimate valuation of that land and improvements per acre based on this amount of net income, money being worth 10 per cent., is only \$100, which just balances the actual cost of the trees brought to bearing, and leaves nothing to represent the value of the land. Of course the income of \$1,025 is, with other things, an inducement for labor, but it is absolutely none for the investment of capital in ten-acre landholdings.

As a fact, in this year of 1894 the profit margin is practically wiped out, and growers will be fortunate who realize sufficient to repay the farm cost of production. Undesirable as is this present condition, the outlook for the future is even more unpromising. The inevitable increase in production of fruit must find an increase in consumption to absorb it. This means a market among classes of people that the fruit does not now reach, and to be taken by them the mean sale value must be lower for the whole production to meet their ability to pay.

The future sale value is then certainly less than the present one, just as the present sale value is less than that of five years ago. This inevitable decrease in sale value can be compensated for and the margin for profit increased in only one way. The cost of production must be reduced, and in absolute amount a considerable sum. An examination of the several items of the cost of production given for the box of peaches will show only one large enough in amount, the freight, to be materially reduced. This as it now stands is 61 per cent. of the total, where the highest other single item, the box, is only 9 per cent. It is clearly evident that unless the freight item of cost be materially reduced, small landholdings producing fruit cannot be made safely profitable, and those that now exist will be absorbed by the larger landholdings.

The peach has been taken as the extreme favorable case for the small landholder. It is the peach that by the profits of its production a few years since has developed the unearned increment of Northern California lands, just as it has been the orange that has done a like service for the Southern California lands. It has been the development of this unearned increment by the profits of the first in the industry which has made small landholdings desirable. In amount this unearned increment has exceeded many times the basis value of the wild land, or the land used for staple production.

Take Placer County, concerning which I am best advised as to the facts, for an example. In it, in 1891, there were just 6,000 acres of irrigated land in about three fourths of its maximum possi-

ble production, that is, it was not all in full bearing. The figures taken from the assessment roll show an appreciation in value, such a development of the unearned increment as to seem hardly credible. The following figures are made from the assessment roll of 1891, and include the exclusively agricultural land lying below an elevation of 1,500 feet, being all of the county west of a line drawn north and south two miles east of Auburn. Mining claims and towns are not included. The landholdings for more effective comparison are segregated into valley or plain lands, part of the Sacramento Valley; unirrigated foothill farms and irrigated foothill farms.

VALLEY LANDS.

Number of farms assessed.....	225
Total acreage.....	143,386
Average acreage per farm.....	637
Total assessed valuation of land.....	\$1,544,703
Average assessment of land per acre.....	10.77
Total assessed valuation of improvements.....	153,179
Average per acre.....	1.06
Total land and improvements...	1,697,882
Average per acre.....	11.83

UNIRRIGATED FOOTHILL FARMS.

Number of farms assessed.....	599
Total acreage.....	85,313
Average acreage.....	142
Total assessed valuation of land.....	\$1,075,956
Average valuation per acre.....	12.61
Total assessments of improvements.....	161,684
Average per acre.....	1.90
Total land and improvements.....	1,237,940
Average per acre.....	14.51

IRRIGATED FOOTHILL FARMS.

Number of farms assessed.....	328
Total acreage.....	30,272
Average per farm (acres).....	92
Average per farm irrigated (acres).....	18.4
Total assessed valuation of land.....	\$715,501
Average per acre.....	23.63
Total assessed valuation of improvement.....	334,953
Average per acre.....	11.06
Total land and improvements.....	1,050,454
Average per acre.....	34.69

From these figures, and those of actual sales, the value of the unearned increment of the actually irrigated and bearing foothill

lands is \$280 an acre, fourteen times the mean sale value of contiguous unwatered land in the foothills, and fifteen times the mean sale value of the valley wheat lands. The sale figures show \$100 an acre additional as the unearned increment of the bearing trees. The aggregate of these two for the 6,000 acres of irrigated land is \$3,800,000, all of which, and another undetermined amount in town real estate and improvements, is the earning power created by large net earnings from the sale of the small farm product, fruit. The actual amount of this unearned increment appearing on the assessment roll for the year 1891 was \$970,000. But the large net earnings of the land on which these values were based were not the net earnings of 1891, but of preceding years. In 1892 there was only a small profit margin, as closely as it can be estimated about 15 cents to the 25-pound box of peaches. In 1893 even that practically disappeared, and in this year of 1894 it has more than disappeared. Values remain, just as they do for the wheat lands, but, just as in the case of the wheat lands, they are only a survival, what was, not what is. They were wealth producing, they are not now. The possessors cling to them only in the hope of realizing on them through a sale to some outsider who is not expert enough to comprehend the real condition.

The statistical figures already given, and some others here stated, furnish the basis for conclusions relevant to society as between conditions of large and small landholding, which are equally instructive with those presented in Mr. Mills' paper. The 6,000 acres of fruit farm lands in 1891 directly supported a population of not less than 1,500, and town population adjacent of 1,000, in addition contributing to the support of another distant population engaged in box and paper making. The 85,000 acres of unirrigated foothill farms did not maintain directly and indirectly more than 1,100 people. The 143,386 acres of plain farms furnished support for only 1,500 people. The density of the supported population is at the rate of 265 to the square mile for the small farm fruit area, and only seven to the square mile for the large farm areas. The latter has been for years decreasing in population, one town, Sheridan, has practically disappeared in the last ten years, and another, Roseville, is tending the same way.

On the small fruit farms are comfortable modern dwellings and conveniences, and the surroundings are made attractive, indicating leisure and the accumulation of wealth, or the anticipation of its accumulation. Schoolhouses and churches are cheerful looking build-

ings, and are well supported. The reverse of these facts is the rule of the other farms and their localities. While mortgages that cannot be accounted for, as the unpaid balance of purchase price of the land, expenditure for improvements, or capital employed in other occupations, only amount to 12 per cent. of the assessed valuation of the improvements alone on the small fruit farms; on the valley farms these mortgages amount to the entire sum of assessment of improvements, and to nine per cent. of the assessment of the land besides. The fruit growers are constant travelers by rail, the others are not. The 6,000 acres of fruit farms furnished, in 1891, 1,500 carloads of outgoing products, and 500 of incoming supplies, more than these figures rather than less. The 85,000 acres of other foothill farm, and the 143,386 acres of valley farm, during the same year furnished in outgoing freight not over 500 carloads, and in incoming not over 150. The first pay high rates on long hauls, and the second pay for short hauls at low rates.

Placer County in itself shows the undesirable tendency toward the growth of large landholdings, and in itself as well the desirable tendency toward the multiplication of small landholdings. The very closeness of contact of the two forces contrasts them the stronger. The causes that have been operating to make business failures of one class of agricultural industry, the causes that have operated to make business successes of another, are alike comprehensible and measurable. The relation of these two classes of causes to transportation is clearly defined. Nowhere is more clearly established the fact that the underlying value of a railroad is not in its track and rolling stock, but in its people and its country.

Now if the wealth-developing power, which has made small landholdings desirable, can be maintained instead of disappearing, population will increase instead of decrease, the extension of large landholding will be checked, and ultimately turned the other way. On precisely even terms the small landholder will beat the large landholder in the economy of production, and will ultimately displace him. It is the certainty of the maintenance of the developed values, and the certainty of even terms between individuals that is wanting. Neither exist. The decreased margin between the cost of production and the sale value of the small farm products has wiped out the possibility of profit, and with it the wealth development of the small landholdings. This is realized by the small landholders, and finds expression in efforts to reduce the cost of production along the line of least resistance. Labor has been

reduced in remuneration till its compensation is so small that further yielding in that direction is impossible. The cost of packages has been pushed down to the unyielding point. No item of cost has not been too small not to have been magnified in relative importance and efforts made to reduce it. Taxation has been tinkered with, and precisely the wrong thing done. Irrigation water, which takes the least of the product and gives most in return, has been made the scapegoat for failure of profit.

These misdirected efforts to reduce the cost of production, misdirected because the aggregate of all of the possible gains is insignificant as compared with what is necessary, have created an uncertainty as to the future in the minds of those who should be best able to forecast it, that extends to all business enterprises that otherwise would be put in operation. Capital will not invest in colonization, irrigation or manufacturing in the face of this uncertainty. The element of security is wanting. It is the real reason why population and small landholdings are decreasing instead of increasing, for the small owner of wealth is just as anxious as the large owner to have security that he shall keep what he has gathered together.

The present industrial and trade condition in California is simply the logical resultant of the persistence for the last twenty-five years of the reckless business policy of its great distributive agency, the Southern Pacific Company. This policy had its inception at the close of the time and business methods when the production of California was wealth itself, gold dug out of the earth, not obtained as the difference of exchanges of consumable products. Taking all of this gold it could, it still left some to the producer, and the ultimate effect of its persistence was not foreshadowed. Persisting in its policy after the wealth-producing power of California became less in the gold taken direct from the earth, and more in the difference of exchanges of its sun and soil products, the amount taken has closer and closer approached the whole of this difference. The fruit production development, commencing ten years ago, was to the Southern Pacific Company like the old yield of the gold mines come back again. To the producers, the people who brought that gold in from the outside, what the Southern Pacific took while waiting for their trees to bear was a part of their investment of capital, not a charge against their gross income, which would wipe out the possibility of their being any net income. The ultimate effect was not foreshadowed to these fresh producers, the old ones drained, remained silent, perhaps they too might find fresh producers. It

has been the old fable of the goose which laid golden eggs over again, only California is a bigger goose than the one in the fable.

In this year of 1894 the logical resultant of the persistence of the reckless business policy of the Southern Pacific Company is an actuality, a fact. The earning power of some of the most sun-blest land on the earth has been pushed down below the profit point, and the land made undesirable, population has decreased, wealth has disappeared. That the business and industrial fabric stands at all is only because it is a habit, its real stability is that of a soap bubble, of wind.

In conclusion, if California is not to be a failure, action is an imperative necessity. Great as are her natural resources, the wealth they have produced so far, and what is left of their wealth-creating power, has been made an appurtenance of the Southern Pacific Company. Not producing anything, merely distributive of the energy of producers, as its share for that distribution it is taking so much that there is nothing left for the producers. The remedy for this condition is obvious and simple. The Southern Pacific Company must take less of the production than it has been taking, not a little less but a great deal less. It must take less, voluntarily if it will, if not it must take less by being made to. It is either that remedy, or else ———

There is just one other stage of California landholding. Mr. Mills does not state it, but it is just the same inevitable under the persistence of existing conditions. The State will have just one land monopolist — the Southern Pacific Company.

Continued from page 550.

CENTRIFUGAL PUMPS.

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To give some idea of the extent of centrifugal pumping in Europe, there is given below a list of some of the largest plants made, by two firms only, previous to 1892.

Where Erected.	Name and Address of Makers.	Tons of Water Raised Per Minute.	British Gallons Raised Per Minute.
Amsterdam Canal.....	Easton & Anderson, London, Eng.	700	188300
Witham, England.....	Easton & Anderson, London, Eng.	400	107600
Hauvill, Denmark	J. & H. Gwynne, London, Eng....	230	61870
Grootslag, Polder, Holland	J. & H. Gwynne, London, Eng....	240	64560
Bijlmer Meer, Holland....	J. & H. Gwynne, London, Eng....	150	40350
Amsterdam, Temporary...	J. & H. Gwynne, London, Eng....	120	32280
Whittlesea, England	Easton & Anderson, London, Eng.	88	23672
Portsmouth, England	Easton & Anderson, London, Eng.	130	34970
Glasgow, Scotland	Easton & Anderson, London, Eng.	175	47075
Cronstadt, Russia	Easton & Anderson, London, Eng.	300	80700
Sajfoji, Hungary	J. & H. Gwynne, London, Eng....	100	26900
Loosdrecht, Holland	J. & H. Gwynne, London, Eng....	140	37660
Legmeer Plassen, Holland.	J. & H. Gwynne, London, Eng....	150	40350
Ferrara, Italy	J. & H. Gwynne, London, Eng....	2100	564900

The list includes only the larger plants, perhaps not one half the whole number. Gwynne & Co., whose pumps are not mentioned in the list, have supplied previous to 1879 more than thirty plants for docks.

For a few years past there have been fewer large pumps erected than during a corresponding number of years previous, but the manufacture and application of the smaller sizes of pumps has been all the time increasing.

One extensive use recently developed has been for circulating water in surface condensers. There is scarcely a large steam vessel without such pumps.

Some recent examples of large pumps in England that may be mentioned, are the Sandon Docks at Liverpool. The pumps, and all the machinery connected with them, except boilers, were constructed by Messrs. J. & H. Gwynne, of Hammersmith, London. There are four pumps, each with discharge pipes of 36 inches diameter. The wheels or fans are 60 inches diameter, and run at 160 revolutions per minute. The quantity discharged in an experiment made in March last was 23,445 cubic feet, or 164,115 gallons per minute. The engines, four in number, have cylinders 30 inches diameter and 24 inches stroke. The pump wheels are keyed directly on the engine shafts. This plant, all things considered, is perhaps the most perfect of any one of its class that can be referred to at this time.

At Wall's End Docks, Newcastle, England, is a plant constructed during 1885 by Messrs. Tangye Bros., Limited, Birmingham. There are two pumps, with pipes 36 inches diameter, and rated for 50,000 gallons per minute. There has been no published test, however, and the amount of duty will, no doubt, much exceed what is named above. The pumps have single inlets, and are driven by directly-g geared vertical engines 20 inches diameter and 18 inches stroke. The discs or runners are 66 inches diameter, and are balanced one against the other by a continuous shaft passing through both pumps.

Another plant at Alexandria Docks, Hull, England, consists of four pumps to raise 80,000 gallons per minute, driven by two engines of 400 horse power, the cylinders being 30 inches diameter and 24 inches stroke.

The pumps are of the J. S. Gwynne type, the casing parted on the line of the pump spindle: strong, massive and with some change as to form from the practice of the firm some years ago.

One feature that commends itself is tapering the suction pipes. The lift is 24 feet at the extreme. The up-flow becomes tardy at this height, and requires area to compensate for loss of movement. The plant has been much increased since 1886.

The centrifugal water-raising machinery constructed in England during 20 years past may be estimated at equal to raising 20,000 tons a minute. The lift in graving docks is from 25 to 30 feet. At Cronstadt it is 39 feet, and at Malta $39\frac{1}{2}$ feet. The average, including draining plants, is perhaps 15 feet, and allowing one horse power for each ton per foot per minute it will aggregate 300,000 horse power, and of value at least \$30,000,000.

Since the foregoing was written, in 1886, there has been noted progress in larger centrifugal pumps in this country. A number of

dock plants to raise from 30,000 to 40,000 gallons per minute have been made in the East by the Southwark Foundry, at Philadelphia, and a number of pumps of equal size have been made and erected in California for draining purposes.

In future we may expect works as extensive as have been erected in Europe, perhaps larger, because the areas to be drained, or that may be drained, when land is dear enough to permit it, far exceed the requirements in Europe. The largest pumps will, no doubt, be those for circulating water in some of the cities around the North American Lakes. Some proposed for Cleveland, Ohio, some years ago, required pipes of 60 inches bore. At New Orleans there is need of a number of such pumps for flushing and carrying off the sewage to Lake Pontchartrain. This work is now performed by lift wheels, at a fair economy in power, but with great waste for maintenance and attendance.

CENTRIFUGAL PUMPS AND HIGH HEADS.

At this time the problem of most interest in centrifugal pumping is in respect to high heads, especially on the Pacific Coast, where there is no choice between centrifugal and piston pumps in raising water from bored wells. The sand and gravel that come up with the water continually, prevents the use of piston pumps of any kind, and centrifugal pumps must be employed.

The heads operated against, down to three years ago, did not exceed 100 feet, but since that time they have increased, as will be seen from examples in the appendix, to 160 feet without developing any circumstance that points to a limitation, and the makers of such pumps have no fear of working with fair economy against heads of 200 feet or more.

There is no subject which at this time more strongly appeals to what may be called public facilities for confirmation by practical tests. No maker of centrifugal pumps is likely to, or can afford to, conduct such experiments, except for his own information and advantage. Computations, as we have been obliged to assume, do not fit the facts of operating, especially in respect to high heads, and there is, besides, the problem of transforming the discharge velocity from the impellers so as to utilize in the fullest manner the energy of revolution, it may be called.

The latter is but briefly treated here, because the behavior of the water cannot be observed or predicated with certainty, and nothing but experiments will determine the best form for chambers and water ducts beyond the impellers.

APPENDIX.

The following appendix, consisting of communications from engineers and makers of centrifugal pumping machinery on the Pacific Coast, it is believed will be a valuable addition to the matter that has preceded.

Professor Hesse was concerned in some experiments carried out in San Francisco in 1865 to determine whether the process called "disintegration" could be successfully applied to the reduction of gold and silver ores.

Disintegrating machines are driven at a velocity of about 1,800 revolutions per minute, and to insure a uniform effect in the crushing cylinder, the shaft was set vertical. As a test for resistance to rupture, the whole was set in a pit, with the plane of revolution below the surface of the ground, and in this condition rotated at a speed of 3,000 revolutions per minute. The weight carried on the step was about 800 pounds. The step soon "froze," as it is called, welded itself solid in the matrix, so that some new method was required. It was at that time, 1865, that Prof. Hesse prepared plans for a hydraulic step by which the weight on these spindles was to be supported by pressure due to centrifugal force acting on one side of a plate or disc.

In 1887 he introduced the subject before the engineering classes in the University of California, and instituted a number of experiments to determine pressures, resistance and friction of discs with and without vanes revolving in water at high velocity.

These experiments form the subject of Bulletin No. 2, referred to in his communication below. Copies of it can be had at this time by applying to Prof. F. G. Hesse, at the University of California, Berkeley.

COMMUNICATION FROM PROF. F. G. HESSE.

UNIVERSITY OF CALIFORNIA, BERKELEY.

"The work lost, or the mechanical equivalent of the heat developed by the rotation of a body in water bounded externally by fixed rigid walls, is a function of the geometrical figures of the rotating and stationary bodies, and of the velocity of rotation.

In our problem, a disc, plain or armed with ribs, rotates about its geometrical axis within a body of water, bounded by a surface of revolution of the same axis.

"Let us consider a plain rotating disc, etc. Friction between the face of the disc and the water (outer friction) induces rotation of the adjoining layer, which in turn is transmitted by the actual action of the molecules (inner friction) at a decreasing rate, until the rotary velocity of the film in immediate contact with the bottom of the vessel is zero.

"The rotary velocities induce again radial currents from the axis in the neighborhood of the rotating disc, and toward the same near the bottom of the vessel, and, in conformity with the law of continuity, component velocities normal to the rotating disc complete the circulation. For the sake of brevity I have omitted the influence of the outer boundary. The moment of resistance of the rotary disc must be equal to that of the vessel, a fact upon which the tests, as described in Bulletin No. 2, were based.

"Practically the outer friction is by far the most important factor in the heat development, and we are justified in constructing the formula upon the following experimental facts, using the annexed notation :

A represents the water area.

v , velocity of rotation.

λ , a constant.

R , the resistance.

γ , the density of the fluid (water).

w , angular velocity of the disc.

n , number of revolutions per minute.

$$R = C \gamma A v^2$$

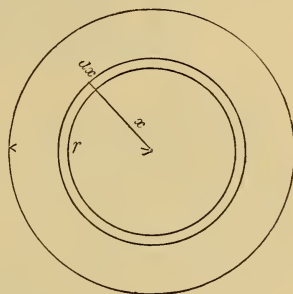


FIG. 17.

"Applying the above to the rotation of a plain disc (Fig. 17) we have differential of R that is $dR = \lambda \gamma 2 \pi x dx w^2 x^2$, and differential of moment of resistance, that is, $dM = \lambda \gamma 2 \pi w^2 x^4 dx$, hence

$$M = \frac{\lambda \gamma 2 \pi w^2 x^5}{5}$$

$$\text{and } L (\text{work}) = \frac{\lambda \gamma 2 \pi w^3 x^5}{5} \quad \text{or}$$

$$L = \frac{\lambda \gamma 2^4 \pi^4 x^5}{5 \times 60^3} n^3 = \frac{\lambda}{10} d^5 n^3,$$

or for compound action $L = \frac{\lambda}{10} d^5 n^3 m$ (the same result as given in Bulletin). The constant λ is a function of n and d . (See Bulletin page 21.)

"I call attention to the fact that the value of λ , hence the work in the case of the rotating disc being armed with ribs, is nearly 2.8 that of the plain disc. This is due to the rotation of a large body of water at a velocity equal to that of the disc, and also to the resisting action of the outer or circumferential surface of the vessel."

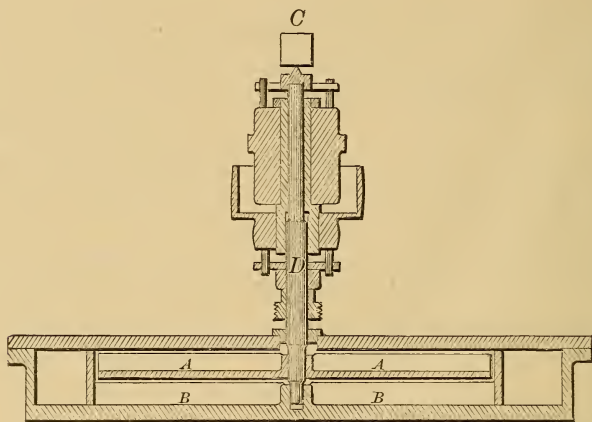


FIG. 18.

Fig. 18 shows part of the apparatus employed by Prof. Hesse in his experiments for thrust. The vanes A are attached to the revolving disc, and the vanes B are fixed to prevent rotation of the water beneath the disc. The spindle D is free from all frictional resistance vertically, and presses on the abutment C connected with suitable weighing apparatus to determine the vertical thrust.

The apparatus employed by Prof. Hesse was of a very complete character, accurately and carefully made, and the observations were recorded by equally exact means, in some cases by electrical devices, as explained in the text and drawings of the Bulletin No. 2 before referred to.

CAPACITY OF CENTRIFUGAL PUMPS.

An extract from a paper read before the Technical Society of the Pacific Coast, June 2nd, 1893, entitled "Some Problems in Pumping Fluids," by J. Richards.

"This comparison has been made to show the economical difference between continuous and intermittent action, which is the chief distinction between these two methods of pumping. There is no reason why 1,200 gallons per minute could not pass through the piston pump the same as it does through the centrifugal one, if there were not limitations of some kinds that take away nine tenths of the capacity of piston pumps. The relative capacity of piston and centrifugal pumps is shown in Figures 19 and 20, representing the waterways, and approximately the volume in the suction pipes, pumps and discharge pipes.

As at first remarked, this difference between the two methods of pumping seems to rest in 'constant flow' in one case, and 'intermittent flow' in the other case, which is mentioned at this time in advance of its proper place to enable a better understanding of some further comparisons to be made. By examining lists of centrifugal

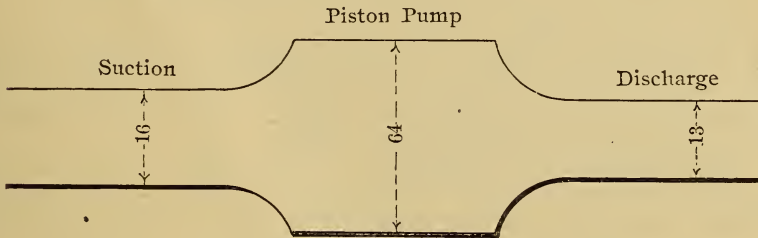


FIG. 19.

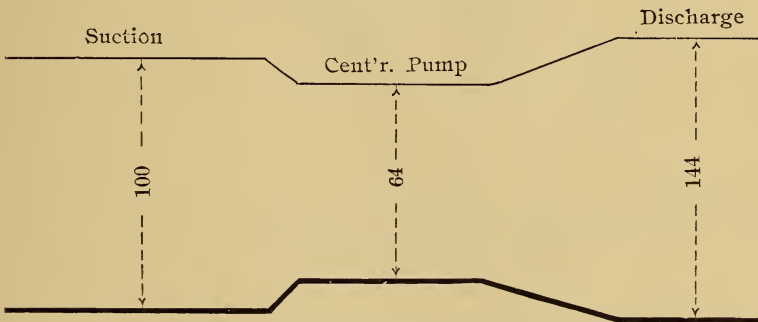


FIG. 20.

and piston pumps it will be seen that the suction and discharge pipes of the former are made of a larger diameter than the pump's bore. In this State the smaller class of centrifugal pumps are usually made with discharge pipes having four times the capacity of the pump nozzles, the suction pipes the same. To quote an example, or several examples now in mind, the diameter of the pump

nozzles are 5 inches; diameter of the up-take pipes, 10 inches. Suction pipes, of which there are from two to four, 6 inches; suction inlet to pumps, 8 inches. With larger pumps these proportions do not hold, but the pipes are in all cases made larger than the pumps to which they connect.

Turning to piston pumps we find the pipes with capacity only a third or fourth as much as that of the pump's bore, or, comparing with centrifugal pumps, about one seventh as large, and are in proportion to the flow in the two cases. Here then is an anomaly, two machines for impelling water under like conditions for average heads, one costing twice as much as the other and performing one tenth of the duty. Behind this must lie some potent feature of method or operation which we find primarily in the difference of velocity at which the fluid passes through the pumps, and from that can lay down a first postulate as follows:

The dimensions, weight and first cost of pumping machinery are inversely as the velocity with which the water passes through it.

The velocity which we have seen is as ten to one, or thereabout, can be illustrated in the two cases by diagrams, as in Figures 19 and 20, where the ordinates represent the diameter or capacity of the water ducts in the suction pipes, pumps, and discharge pipes as taken from actual practice here in California.

This branch of the subject can now be left to trace out the causes of this difference, and why, as in the case of piston pumps, water is moved by 'jerks,' to so call it. This limitation is found

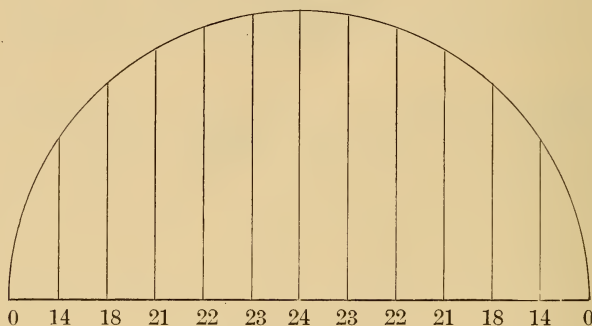


FIG. 21.

in the variation and cessation of velocity of the water in the pumps and usually in the suction pipes, and when considered as a dynamical problem the wonder is that a flow of even 1.5 feet per second can be attained in this manner of pumping.

The ordinates in Fig. 21, and the figures set opposite, represent one stroke of a crank-moved pump piston, showing the changes of velocity, and from this we can derive a second postulate as follows:

The limitation of capacity in reciprocating piston pumps amounting to from eight to nine tenths of their normal capacity is due to intermittent and irregular flow."

FROM THE SAN FRANCISCO TOOL COMPANY.

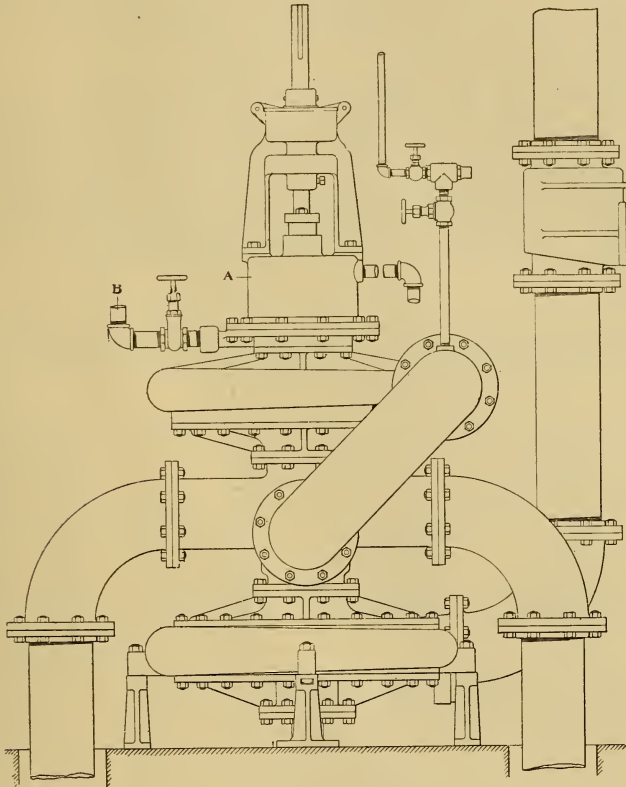


FIG. 22. COMPOUND VERTICAL, CENTRIFUGAL PUMP.

The following matter, with the drawings, has been furnished by the San Francisco Tool Company, and will constitute a problem of much interest in connection with our present subject.

The result seems phenomenal, considering that the water is twice set in revolution, and as often passes through the sinuous ducts of the pumps, but those most familiar with centrifugal pumps and the anomalous results that sometimes appear, will be least likely to criticise the "findings," in the present case.

Some years ago, the writer was connected with the first experiment made in California to raise water against a head exceeding 75 feet, with a centrifugal pump. It was compounded, but so constructed that none of the tangential energy was utilized. When the

two were operating in series they gave precisely double the pressure the first one did, and the power consumed for raising a given quantity of water determined by comparison in the same manner, that is, by fuel consumption, was no more than with barrel pumps that had been in use at the same place.

The present case, and some others to be noticed in this appendix, will bear out no doubt the claim heretofore made, that the art of centrifugal pumping, so to call it, has on the Pacific Coast undergone a development more extensive than in any other part of the world. The arrangement and design of the pumps in this case are well shown in the drawing, and do not call for comment.

Test Made for the San Francisco Tool Company on the Compound Vertical Centrifugal Pump shown in Fig. 22. Campbell Water Company's Works, Campbell, Santa Clara County, California, July 18th, 1894.

PARTICULARS OF TEST.

No. of Test.	WATER.			HEADS.		Revolutions per Minute of Pump.	Net Indicated Horse Power of Engine.	Theoretical Horse Power of Lift.	Per Cent. Efficiency of Pump, including Pump Friction.
	Width of Weir in Inches.	Depth of Water on Weir in Inches.	Gallons.	Total Friction Head, including two check valves.	Total Head.				
1	11 $\frac{3}{4}$	6 $\frac{1}{8}$	529	3.00	111.5	546	20.03	14.90	74.40
2	13 $\frac{1}{4}$	6 $\frac{1}{8}$	596	3.25	115.0	560	24.32	17.31	71.25
3	13 $\frac{1}{2}$	6 $\frac{1}{8}$	607	3.25	116.2	565	25.58	17.79	69.50
4	13 $\frac{3}{4}$	6 $\frac{1}{8}$	619	3.30	117.2	568	26.58	18.60	68.00
5	10 $\frac{5}{16}$	6 $\frac{1}{8}$	465	2.80	108.0	533	22.65	12.69	56.00
6	12 $\frac{1}{8}$	6 $\frac{1}{8}$	545	3.00	111.5	548	22.78	15.35	67.40
7	11 $\frac{3}{4}$	6 $\frac{1}{8}$	529	3.00	111.5	546	25.25	14.90	59.00
8	11 $\frac{1}{4}$	6 $\frac{1}{8}$	506	2.88	110.2	540	24.00	14.05	58.50
9	11 $\frac{7}{8}$	6 $\frac{1}{8}$	534	3.00	111.5	546	22.67	15.11	66.60
10	12 $\frac{1}{2}$	6 $\frac{1}{8}$	562	3.12	113.7	552	26.97	16.04	59.50
11	12	6 $\frac{1}{8}$	540	3.00	112.5	550	24.71	15.35	62.10
Total	134 $\frac{1}{16}$		6032	33.60	1238.8	6054	265.54	172.09	712.25
Average	12.18	6 $\frac{1}{8}$	548	3.05	112.6	550 36	24.14	15.64	64.78

REPORT OF TEST.

Average Total Head.....	112.6 feet.
“ Discharge Head.....	87.5 “
“ Suction Head.....	22.07 “
“ Capacity Per Minute.....	548 Gals.
“ Number of Revolutions Per Minute.....	550.36 R. P. M.
“ Friction Head.....	3.05 Feet.
Diameter of Discharge Pipe.....	7.62 Inches.
“ of Suction Pipes.....	2-7.00 Inches.
Average Indicated Horse Power of Engine Pumping.....	32.04 H. P.
“ Indicated Horse Power of Engine Friction.....	7.90 H. P.
“ Power Applied to Pump Belt.....	24.14 H. P.
“ Water Delivered by Pump.....	15.64 H. P.
“ Efficiency of Pump.....	64¾ Per Cent.

NOTES.

In the above tests the pump was in a pit 82 feet below the surface of the ground.

Power was transmitted to the pump by means of shafting, of which there is about 90 feet of $2\frac{1}{4}$ inch, and 5 couplings, all connected and standing vertically, and held in place by means of about twelve $2\frac{1}{4}$ -inch bearings. The upper end of the shaft runs through a bow frame in the usual manner, and has a $22'' \times 18''$ pulley, and is connected to an Atlas engine ($11'' \times 16''$) by means of a $14''$ rubber belt. Pulley on engine is $66'' \times 14''$.

Distance between centers of engine and pump pulley is 21 feet.

A wooden idle pulley $20'' \times 18''$ running on a $2\frac{1}{4}''$ shaft between two $2\frac{1}{4}''$ bearings keeps the belt taut.

In the above percentages of efficiency no deductions have been made for driving the 2,000 pounds of shafting, couplings, pulley, etc., nor the friction of couplings and pulleys fanning the air, nor friction of the shaft in its many bearings and the idle pulley, neither was the loss in transmission (by quarter turn belt) between engine and pump deducted.

The only deduction made was the friction of engine running light, with driving belt off.

Signed, G. W. PRICE,
R. L. FRIER.

REMARKS.

“This pump replaced a pair of $16''$ bore $\times 48''$ stroke Cornish pumps, which were built and put in last March and April by a well-known California Company. Owing to the large amount of sand and gravel carried by the water of these wells the Cornish pumps proved their unadaptability from the moment they were started up. It was a matter of a few hours only before the pump barrels were filled with sand and gravel, even on top of the pump pistons gravel and dirt would pile up to a depth of from two to five feet, the depth being governed by the length of time the pumps would run before breaking down.

"The centrifugal pump was driven by the same steam plant that was used to furnish power for the Cornish pumps. The difference in power required to operate the different pumps was noticeable in every detail.

"In the tests above named the efficiency of the pumps was impaired by an unforeseen length of the suction head, due to a want of supply in the wells. This head sometimes reached 26 feet, giving a flow of only 2 to 2.5 feet per second, estimated as affecting the working result over the whole test of three to six per cent.

"The suction pipes are about 30 feet long, but are perforated from the bottom up to within $26\frac{1}{2}$ feet of the pump.

"In the fourth test the level of the water in the suction pipes was kept close to the limit set by the perforations in the pipes. Just before the fifth test the water went below the perforations, and the pump drew in air and partly lost its priming. This threw the impellers slightly out of balance.

"In the fifth test there was a very small quantity of water owing to air being in the pipes and pump, and the efficiency was low from the fact that the impellers vibrated vertically, which caused more or less friction between the thrust collars and their bearings, and to the small quantity of water discharged.

"By the time that the sixth test was made the pump was fairly well filled again, although there was a very perceptible variation in the quantity and efficiency during the remainder of the test. Still this is a condition which is liable to exist at any time and under different circumstances, so they have been included in the log of tests. From the tests as made the efficiency obtained can be relied upon as representing average results when working under favorable conditions.

"The water delivered by the pumps contained a large quantity of sand, which if introduced through the pipe *B* into the cylinder *A* would in time impair the efficiency of the balancing piston (detail shown in Fig. 11, page 474). To avoid this, and also to balance the shafting before starting the pump, the pipe *B* was continued on up to the surface of the ground, and then connected to a small reservoir in the bottom of the discharge flume, a strainer being placed over the aperture between the reservoir and the flume. In this manner clean water was obtained for the balancing piston. The stem on the regulating valve, shown on pipe *B*, was continued up to the top of the pit for convenient regulation of the pressure in the balancing cylinder *A*.

"The principal features of design and construction of this pump are as follows :

"1st. The proportion of the scroll chamber of the pump is such as to give a velocity of flow which this company have found by their experiments to be the most efficient.

"2nd. The diameter and curve of the impeller blades are so proportioned that the water leaving the impeller has the same tangential velocity when it reaches the scroll chamber of the pump as the discharge water has when passing through said chamber. This avoids all loss of power from shock, impact and eddies, which always takes place in pumps not properly proportioned. To keep these velocities constant it is necessary with the higher heads to use two or more impellers.

"3rd. The weight of the revolving parts must be maintained at all times in equilibrium. The company employ the method of balancing shown in Figures 9, 10 and 11, described on pages 473 and 474 (ante) to sustain pump shafting, couplings, pulley and impellers. Any variation in the suction or discharge heads will not unbalance the shafting.

"4th. The impellers in the pump being inverted they are in equilibrium in so far as end thrust, leaving only the gravity of the rotary parts to be sustained by the balancing piston at *A*."

Since the foregoing matter was in type the engineer of the Campbell Water Company has apprised the makers of the pump illustrated and described in the preceding test and notes, that a large tank was erected at an elevation of 44 feet above the old flume, and the pump discharge pipe connected to this tank of 20,000 gallons capacity, which is filled in about 30 minutes, or at the rate of 666 gallons per minute. The total head, including friction, the engineer estimates at 160 feet, and there is little doubt that it may be farther increased if required.

The most singular part is that there has been no augmentation, or change, in the driving power, and the 44 feet of added head has certainly not produced resistance in accordance with the usually assumed law in such cases, or as the cube of the head or speed. The present case, and others of the kind, disprove by actual experiment any such limitation of head or resistances in centrifugal pumping.

FROM MESSRS. W. T. GARRATT & CO., SAN FRANCISCO.

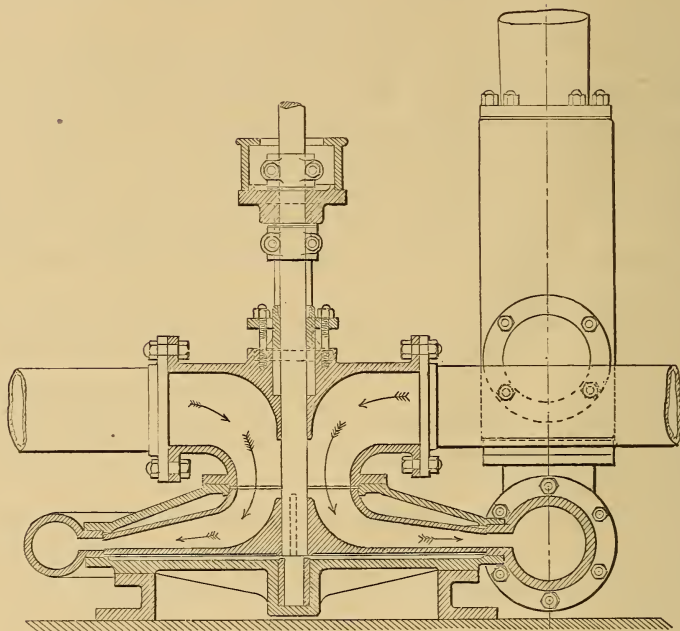


FIG. 23.

PUMP AT THE SAN JOSE WATER WORKS.

The company above named, supply the following interesting facts in respect to the pump shown in the drawing above. The general design, as seen, is simple, and carried out carefully in respect to proportions, curves and section of the waterways, and compares to designs made by the author for Messrs. W. T. Garratt & Co. in 1887, since then extensively applied to raising water from deep wells on the Pacific Coast.

The pump from which the drawing above is taken, is one of five inches bore that has been at work for more than two years past, raising 900 gallons per minute, or at the rate of twelve million gallons in twenty-four hours, against a head of 123 feet, for the city service at San Jose, California.

This is the highest pressure for a single pump operating in constant service that can be referred to at this time. Pumps less

adapted to high pressure have been operated against a head of 130 feet for a time, but not as in this case, for constant daily service.

The following notes are sent by the makers :

"The drawing is to a scale of one sixteenth — $\frac{3}{8}$ inch = 1 foot. The pump was erected about July, 1892. The discharge nozzle is 5 inches diameter, and the impeller 30 inches diameter. The suction pipes (two) are 6 inches diameter. The up-take pipe, above the air vessel, is 10 inches diameter. The engine employed is of 50 horse power, rated, and speed of the pump about 700 revolutions per minute.

"The driving shaft is about 90 feet, and with attached weights, such as pulleys, couplings and pump parts, amounting to more than a ton, is perfectly balanced by water thrust beneath the impeller, the shallow vanes there being trimmed at the works to balance at a low head, the shaft and its fittings compensating for added head up to 123 feet.

"The foot pounds of work, 922,500, make about 28 horse-power, and, while no accurate tests have been made, we believe the efficiency to be as high as 60 per cent., and quite as much as can be attained with a piston pump, such as is commonly employed under the conditions. The water is drawn from gravel strata through tube wells, and contains a great deal of sand and grit that would soon destroy pumps having sliding surfaces.

"In experimenting with the pump there was developed some anomalous conditions of working, not explainable by our previous experience. At an increase of speed from 700 to 800 revolutions or more, the work fell off to some extent, and there is apparently a determinate volume or flow at which the greatest efficiency is attained.* The water is balanced according to the usual formula $V = \sqrt{2gH}$, or at 675 revolutions, the impeller being 30 inches diameter. This leaves 75 revolutions to overcome the resistances to flow."

UTILIZING TANGENTIAL ENERGY.

There is an account in *Le Génie Civil*, Vol. XXIV, page 392, of a centrifugal pump designed by M. Schabaver, in which the discharge from the impeller enters an annular chamber consisting of a narrow slit around the impeller, widening out gradually to the discharge chamber. The comparison with common practice is in

*The pump having a cut-off or throat piece, and requiring a definite speed in respect to the head, there is nothing strange in the result above noted. J. R.

gradually reducing the velocity of the discharge water from the impeller, so as to utilize as far as possible the radial energy, compared with discharging directly into the scroll or discharge chamber, gaining thereby inductive effect only.

The utilization of the rotative energy in this manner is not a new subject, in so far as its dynamical treatment. Prof. James Thomson presented before the Institution of Civil Engineers, in England, nearly twenty years ago, a paper in which the utilization of tangential energy in centrifugal pumps was treated from a mathematical point of view, dealing with the forces involved in an abstract way, and proposing a "whirlpool" chamber beyond the impeller.

In 1884-85 Mr. Byron Jackson, of San Francisco, embodied in a series of pumps what he called whirlpool action, the object of which was to absorb and utilize the energy due to the velocity with which the water leaves the impeller. Mr. Jackson's practice corresponds to that shown or described in the Schabaver pumps, but without the diverging sides or expanding chamber between the impeller and the discharge-way, he relying on the increasing section due to increasing diameter, otherwise the action of the pumps is the same.

But even the diverging sides or expanding chamber between the impeller and discharge-way is not new. In 1892, Mr. G. W. Price, also of San Francisco, prepared drawings, which we have examined, for pumps identical with the alleged invention of M. Schabaver, and in which the section of the water way is made to correspond with the diminishing velocities and increase of volume from the impellers outward, so this feature of construction comes back to the Pacific Coast, and sustains our claim of an advanced practice there.

The account of the Schabaver pump, by M. Gérard Lavergne, is as follows :

"The limit for the profitable employment of centrifugal pumps has hitherto been held to be at lifts of 40 to 50 feet, while their best efficiency is found at lifts considerably lower. The combination of two or more centrifugal pumps in series, one delivering into the suction pipe of another, enables them to be used for high lifts without loss of efficiency, but at the cost of some complication and a large initial outlay.* The present article describes methods of construction which have been devised by M. Schabaver to adapt the centrifugal system to high lifts. The object of the construction is to enable

*The amount of "initial outlay" is not great, but is inconsiderable, as can be seen by comparing with Fig. 22, and in any case is not more than half as much as for piston pumps.

the high velocity with which the water must leave the blades of the pump to transform itself into low velocity with high pressure and at the same time to avoid the shocks and eddies by which energy is dissipated at high lifts in the ordinary centrifugal pumps. To effect this purpose the discharge through the wheel casing is taken through a narrow orifice extending round the whole circumference of the casing. This orifice gradually widens outwards so that the water arrives without shock in a spiral collector surrounding the pump and leading into the discharge pipe. The width of the orifice is made such as to give the required flow at the velocity due to the head against the pump, with a coefficient of contraction (about 0.6) allowed for. A series of experiments were made with a pump of this type of 16 inches diameter across the blades, with 4 inches suction and discharge. It was actuated by a 25-H. P. engine whose efficiency measured by comparing the work on a brake with the indicator diagram, was 80 per cent. The efficiency of the transmission was also obtained, and thus by taking indicator diagrams the work transmitted to the pump shaft could be calculated. Diagrams are given of the efficiency of the pump in terms of the lift for deliveries varying from 1 to $4\frac{1}{2}$ gallons per second, in which the lift ranges from 0 to 164 feet. The maximum efficiency is 58 per cent., and was found only with the greatest flow, viz., about $4\frac{1}{2}$ gallons per second. For any flow the maximum efficiency occurred at about 50 to 60 feet lift and increased continually with the flow. The variations of efficiency from one lift to another were also less with the larger flow. The same results are expressed in another set of curves which give the efficiency as a function of the flow. In another diagram the height to which the water was raised is expressed as a function of the speed of the pump. A similar curve being drawn to express the theoretical lift as given by the equation $v^2 = 2g h$, where v is the resultant of the radial and tangential velocities at the various speeds, it is seen that the pump fulfills its purpose very perfectly in reducing the velocity of the water without loss of head.

In another form of pump directed to the same purpose, the blades are made hollow and large, occupying half the volume of the casing and covering half its circumference—somewhat of the form of a hatchet-blade. The blades are set radially, since it is found that the loss by shock at the entrance of the water is insignificant. This arrangement of blades, together with a gradual enlargement of the casing in the radial sense, gives the water, after issuing from between the blades, plenty of space in which to lose its velocity without shock before entering the discharge-pipe. This pump, delivering $5\frac{1}{2}$ gallons per second to 65.6 feet of height, gave an efficiency of 65 per cent., and delivering $6\frac{1}{2}$ gallons to 32.8 feet of height gave an efficiency of 68 per cent. With further experience still better results may be expected."

There is a provoking omission of the efficiency in working at different heads, from 0 to 164 feet. There is also something inexplicable in the statement that "for any flow the maximum

efficiency occurred at 50 to 60 feet lift, and increased continually with the flow." Unless the translator is wrong here, the experimenter was, because such a result is hardly supposable.

The results described in the last paragraph are not surprising. There are several reasons why vanes of the form described should give a good result. The fact of their being set radially shows that the designer attached but little importance to the curve or shape of the vanes.

STEAM AND HYDRAULIC COTTON PRESS.

THE WALKER MANUFACTURING COMPANY, CLEVELAND, OHIO.

The drawing on page 616 shows in perspective a cotton press on the Taylor or differential system, constructed to the designs of Mr. W. H. Bierce, engineer and contractor, of Montgomery, Alabama. A similar machine was constructed about one year ago, erected at Houston, Texas, one recently for Galveston, Texas, and a third is now under construction.

The purpose of this apparatus is the compression, under a pressure of about 2,000 tons, of regulation size cotton bales into flat bales, occupying about one third of the usual space, the object being to economize space to the greatest degree in shipping.

The general arrangement of the machinery is clearly shown in the engraving. The press rests upon a foundation 18 feet by 10 feet, and stands when closed 26 feet high above the floor line, and when open extends 5 feet below the floor. The upper platen is supported at its ends by heavy housings. Its lower surface, as well as the upper surface of the lower platen, is provided with grooves of a dove-tail section to allow the insertion of the hoop-iron straps, which hold the bale in shape, after it is compressed. On top of this upper platen casting rest two heavy hydraulic cylinders of cast steel. These cylinders carry plungers 26½ inches in diameter. The packing rings are of an improved form, which have been found very effective and durable. A heavy cast iron entablature rests upon the top of the plungers, and supports the two forged iron links, in the lower loop of which rests the lower platen.

The links are machine finished all over, and fit accurately the turned surfaces of the upper and lower castings. Their united tensile strength is 10,000 tons. The operation of the press, as will

be readily understood from the engraving, is effected by forcing up the plungers by the hydraulic pressure, thus raising the lower platen.

When open the distance between platens is five feet. The platens are seven feet by two feet ten inches, and a pressure of 2,000 tons would thus be equivalent to 1,400 pounds per square inch of platen surface.

The engine occupies a floor space 17×27 feet, and stands 8 feet high above the floor level, exclusive of steam and exhaust piping. It consists of two steam cylinders placed side by side, each connected tandem to a water or power cylinder. The two steam cylinders are of the same size, their diameters being 64 inches.

The hydraulic cylinders are designated as high pressure and low pressure. The high pressure has a diameter of $10\frac{7}{8}$ inches, and is provided with a copper lining. The low-pressure cylinder is $24\frac{1}{4}$ inches in diameter, and is without any lining. Both are of cast iron with very thick walls to resist the enormous pressures to which they are subjected.

The plungers in these cylinders have a stroke of $9\frac{1}{2}$ feet. The piston rods are 8 inches in diameter, and the couplings between the power and steam cylinders are made very strong and massive, since both have to resist a thrust of about 400,000 pounds.

The hydraulic piping between the engine and press, which has to withstand a pressure of 4,000 pounds per square inch, is made of cast steel, and all the cast-steel fittings have to be very massive to stand this enormous strain. Steam is supplied to the steam cylinders by 7-inch pipes, and its admission and exhaust is controlled by seven balanced valves of the globe pattern.

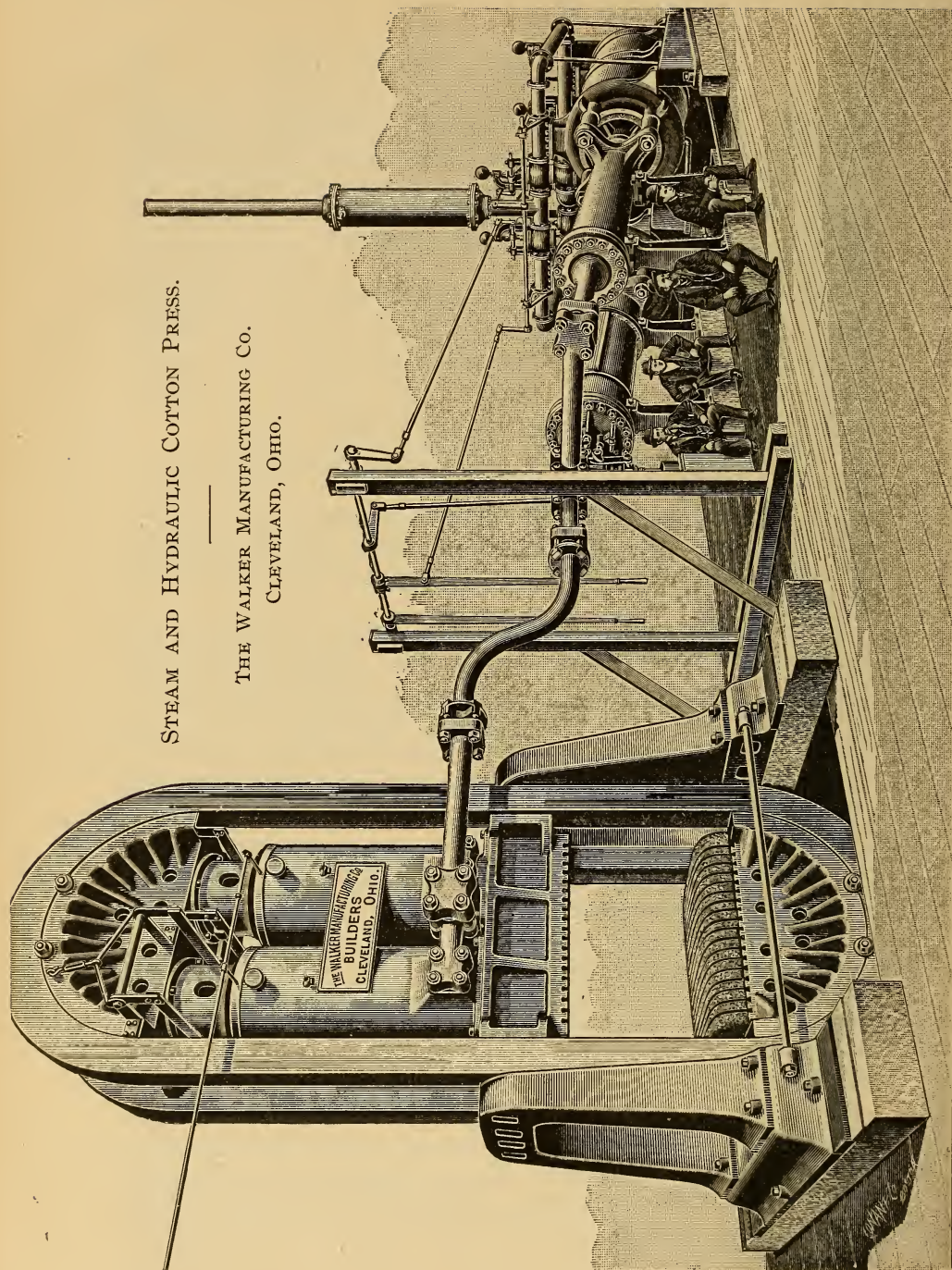
The operation of the machine is as follows:

In starting, both pistons being at the back ends of their cylinders, steam from the boilers, at 125 pounds pressure, is admitted to the low-pressure side. The low-pressure piston moves forward, forcing the liquid into the hydraulic cylinders, and thus raising the lower platen with the bale. The movement ceases when the pressure on the bale reaches about 400 tons, and balances the steam pressure. This requires about three fourths of the stroke of the power piston. Steam is then admitted to the high-pressure side, and the high-pressure power piston advances until the pressure on the bale is 2,000 tons, which again balances the steam pressure.

When the press is in this condition the pressure in the hydraulic cylinders and piping is about 3,800 pounds per square inch, and the

STEAM AND HYDRAULIC COTTON PRESS.

THE WALKER MANUFACTURING CO.
CLEVELAND, OHIO.

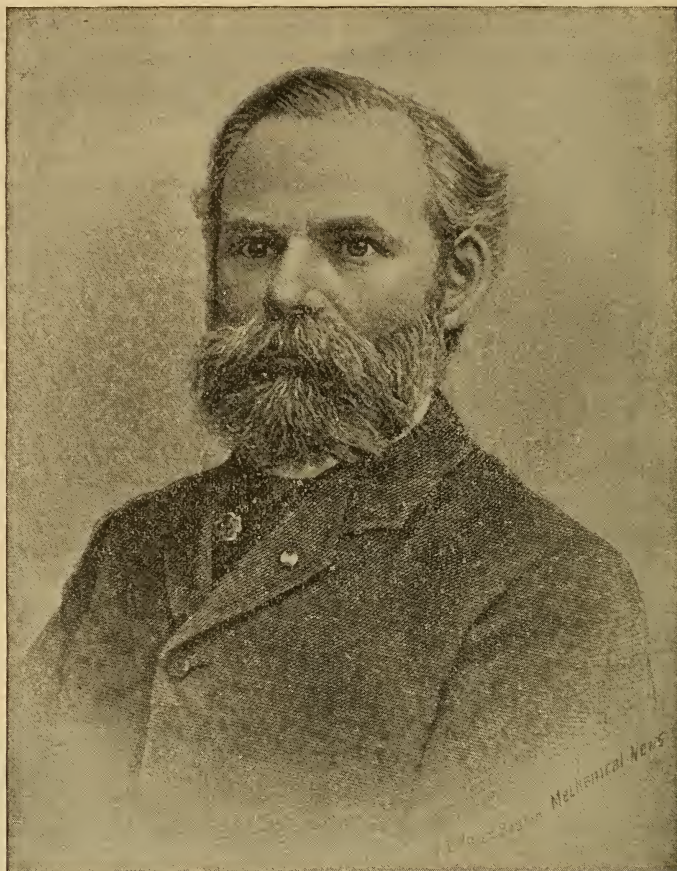


thrust on the power piston rods is 400,000 pounds. When the high-pressure piston begins to act, a check valve situated at the end of the low-pressure cylinder prevents the increased pressure from reaching the latter. As soon as the binding straps have been applied to the bale, communication is established between front and back ends of the steam cylinders, thus equalizing the pressures on the opposite faces of the pistons, and immediately afterwards when the pressure on the bale is relieved the check valve is lifted. The weight of the parts, the links, the entablature and lower platen, and the hydraulic plungers, is sufficient to open the press, forcing the power pistons back to their starting positions at the back ends of their cylinders, and leaving everything in readiness for the next bale.

After the first cycle, however, the process is slightly different, for instead of using live steam on the low-pressure side the exhaust from the last operation of the high-pressure side is used, all the other steps of the process being as above described. The exhaust from the low-pressure side passes through a feed-water heater into the atmosphere. It will thus be seen that advantage is taken of the expansive action of the steam, and the economy of operation thereby augmented. In its regular working, therefore, the machine is in effect a compound engine.

All of the movements of this immense cotton press, aggregating 300,000 pounds, are controlled with the greatest ease by only two levers, as shown in the engraving, which considering the mammoth proportion of machinery seems incredible that it can be handled with such dispatch in operations. The press has a capacity of 1,200 bales in ten hours under average working conditions, and on a time test has reached 1,550 bales in ten hours.

There are but few shops in the country with facilities for handling such heavy work as these presses. The works of the Walker Manufacturing Company were selected by Mr. Bierce for the building of his machinery, after a careful investigation of the facilities of some of the larger shops seeking his work, and the selection under these conditions bespeaks the superiority and general fitness of the equipment of this company for the manufacture of heavy machinery.



PROF. ROBERT H. THURSTON.

DIRECTOR OF SIBLEY COLLEGE, CORNELL UNIVERSITY.

There are few, perhaps no readers of *INDUSTRY*, who will not know, without recountal here, the position and professional work of Prof. Thurston. The diversity and extent of his writings precludes a list of them. They are nearly all of a permanent form, in advanced branches of physical research, and, as before remarked, are well known.

At the close of the Civil War, in which he served as a naval engineer, he was detailed for duty at the United States Naval Academy as A. A. Prof. of Natural and Experimental Philosophy. He entered upon his duties January 1, 1866, and remained at Annapolis six years, leaving the Academy in 1871, and resigning

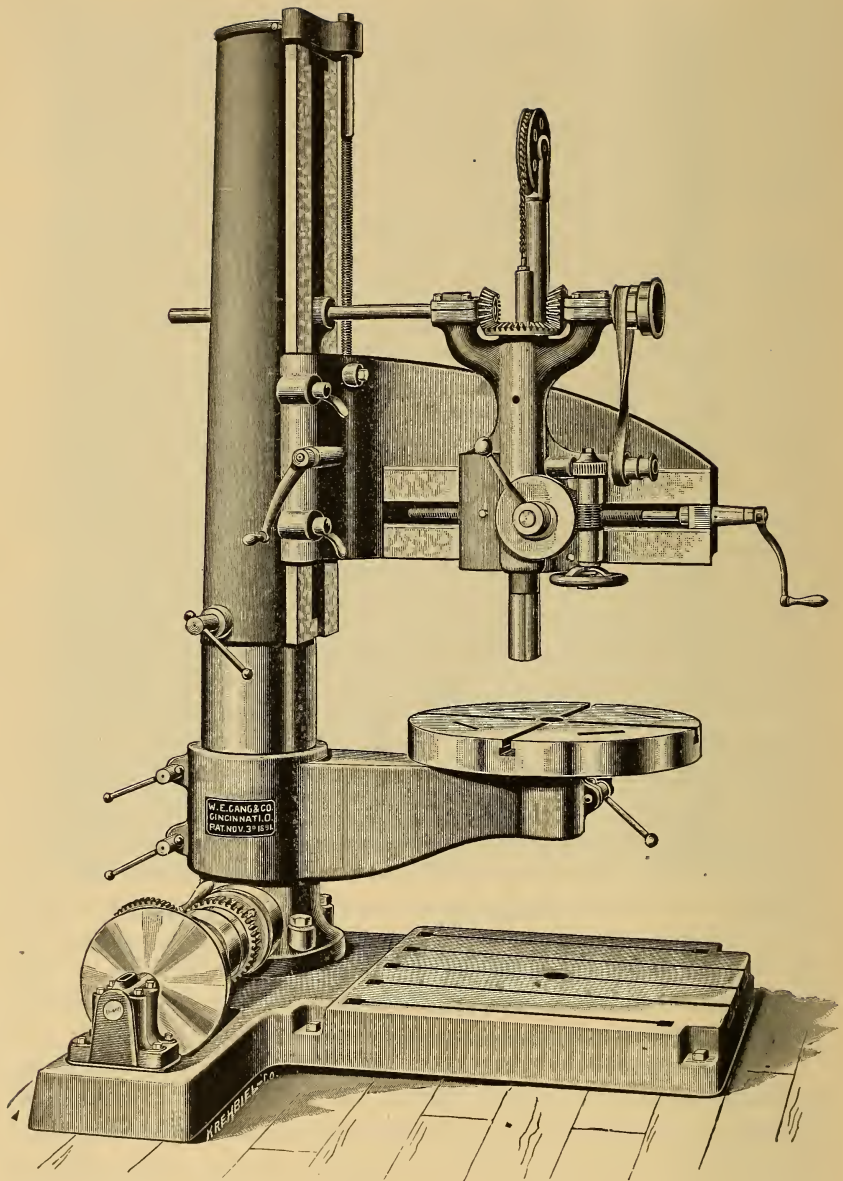
from the navy in 1872. At the Academy he acted as Head of Department during an interim between the death of Professor Smith and the appointment of General Lockwood to the position, and continued for some time to serve as lecturer in chemistry and physics, and giving instruction in applied mechanics. A large number of the now junior lieutenant commanders, and all of the upper grade of lieutenants, were his pupils.

In 1871 he left the Academy to accept the Professorship of Engineering at the then newly-founded Stevens Institute of Technology, and assisted in giving that institution its form, in planning its courses, and in inaugurating its work. He remained in that position fourteen years, resigning in 1885 to accept the directorship of Sibley College of Mechanical Engineering, Cornell University, a position created to enable him to organize that institution as a College of Mechanical Engineering and the Mechanic Arts. Meantime he had, about 1873, organized a Laboratory of Engineering Research, the first of its kind in the country, and instituted many interesting and some important investigations.

In 1873 he was appointed one of the commissioners of the United States to the International Exhibition at Vienna, and served as a member of the International Jury. Later he made a tour of Great Britain and the Continent, inspecting manufacturing establishments and public works, and collecting materials for his report to the Department of State. In 1875 he was made editor of the "Vienna Reports," and completed the work, which appeared in four volumes in 1876. He was a member and secretary of the United States Board appointed under authority of Congress to test iron, steel and other metals. He was also, in 1880, first president of the American Society of Mechanical Engineers, serving two terms; three times vice-president of the American Association for the Advancement of Science; in 1884, vice-president of the British Association; in 1879, vice-president of the American Institute of Mining Engineers, and has held various other positions in leading scientific bodies.

Prof. Thurston is a member of the principal European scientific and engineering societies—Officier de l'Instruction Publique de France, honorary member of the Franklin Institute, member of the the American Society of Civil Engineers, member of the Military Order of the Loyal Legion, and chairman of the United States Commission of Safe and Vault Construction.

Prof. Thurston is at the head of Sibley College, Cornell University, which has grown under his administration to be the largest



IMPROVED COMPOUND DRILLING MACHINE.

WM. E. GANG & CO., CINCINNATI, OHIO.

school of its kind in the world, having 600 students, and an elaborate equipment valued at about \$350,000. The portrait of Prof. Thurston, for which we are indebted to the *Manufacturer and Builder*, is a good likeness.

IMPROVED COMPOUND DRILLING MACHINE.

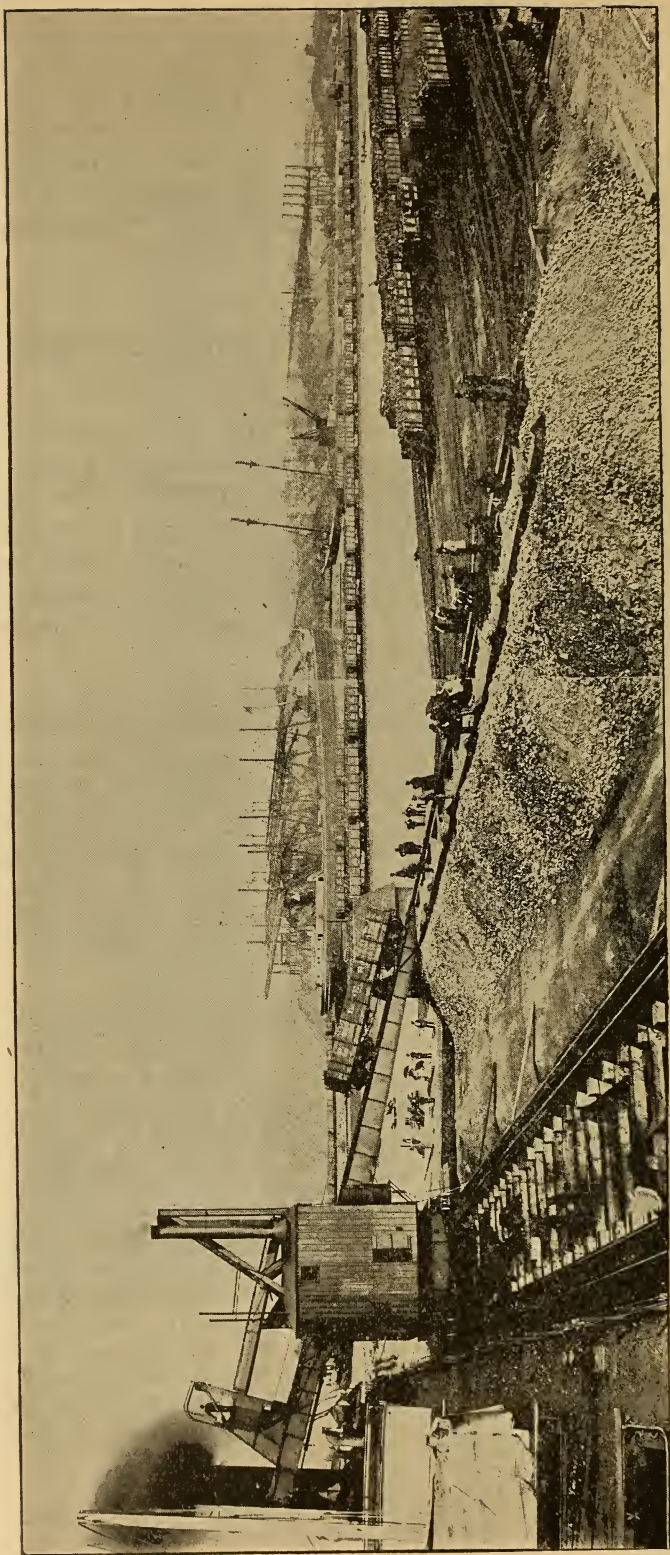
WM. E. GANG & CO., CINCINNATI, OHIO.

The construction of machine tools, we do not consider it a manufacture, has in Cincinnati made marvelous progress in thirty years past. We can well remember when the makers in New England thought that work of this class could not well be done in the Western States, and that the venture in Cincinnati would prove a failure, but the very first tools made there, copied mainly after Philadelphia examples, were of a higher class than could be procured in New England works of that time.

The accuracy of fitting required a period of evolution, but it came in the end, and when to this is added a greater versatility, and a boldness of new design, the Cincinnati makers came to the front, and now send a considerable part of their product back across the Allegheny Mountains, and are contending for the market everywhere. One reason for this is that machine-tool making in Cincinnati has never become a regular "manufacture," as it has in New England. Implements were designed and made for various kinds of special work, and a draughting room was an essential feature in the business.

The present machine, which we have called a compound one, embodies several features of novelty. It has all the required functions of a common fixed drilling machine of the first class, and has, besides, radial and swing adjustments of the spindle, constituting it, when required, a radial drilling machine, is, in fact, a combination of the two. We copy the following from the maker's description:

"The drill has power feed and quick return, with a new balancing device to the spindle. The spindle feed screw and elevating screw are made of steel, and all thrust bearings are provided with phosphor bronze washers. The machine is made in three sizes, drilling to the center of 3-foot, 5-foot and 7-foot circles, respectively. It receives, under the spindles and upon the bed plate, work 4 feet, 5 feet, and 5½ feet. The spindles have taper holes for Nos. 3 and 4 Morse shanks. The machines weigh 2,500 pounds, 3,500 pounds and 4,000 pounds. They are made by Wm. E. Gang & Co., Harrison Avenue, Cincinnati."



COAL-HANDLING APPARATUS.—THE MCMYLER CAR-DUMPING MACHINE CO., CLEVELAND, OHIO.

COAL-HANDLING MACHINERY.

THE M'MYLER CAR-DUMPING MACHINE CO., CLEVELAND, OHIO.

The plates and description herewith, for which we are indebted to the *Marine Review*, Cleveland, Ohio, will, no doubt, prove a matter of interest to many of our readers on this Coast, especially in Washington and British Columbia, where coal loading constitutes a considerable portion of the expenses of transportation.

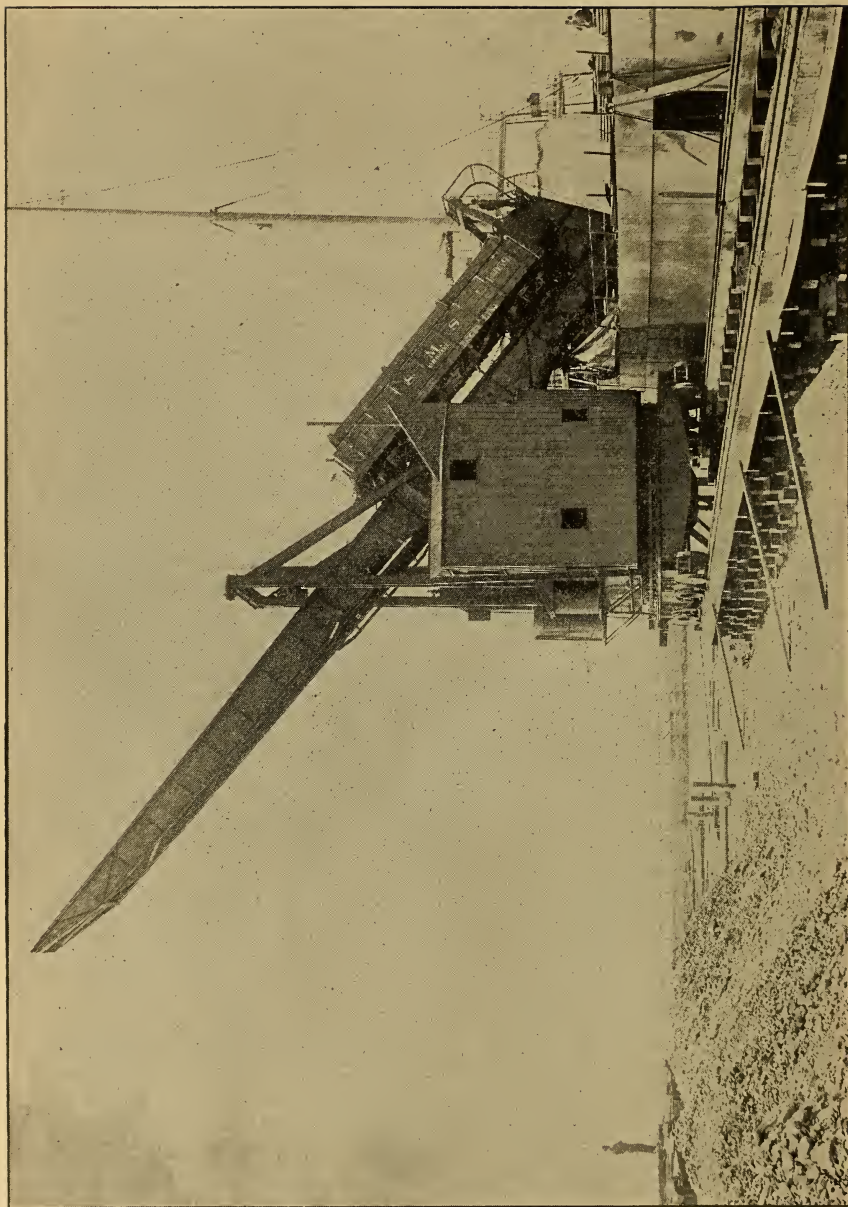
"The transportation of bituminous coal from Lake Erie ports to the Northwest is, next to that of iron ore, the most important item of lake commerce. For several years past shipments of coal from the Pittsburgh, Hocking Valley and West Virginia Districts have averaged about 3,000,000 tons each season. This coal is of a high grade, suitable for fuel and steam purposes, and for the manufacture of gas and coke, and shippers have tried various methods of loading it into vessels without damage by crushing.

As far back as twenty years ago attempts were made to handle coal on the lakes by means of chutes, and on the Cleveland docks of what is now the Big Four Railway, as much as \$65,000 was expended on a single plant that had to be entirely abandoned because of damage to the coal in handling. With the advent of large steel steamers, and wooden ones of largely-increased capacity, rotary derricks handling buckets increasing up to five tons capacity were introduced, but even with these the largest vessels were delayed two to four days in loading. With eight or ten men shoveling into buckets from a car three feet deep there was still the disadvantage of separation in the coal and consequent breakage.

There has been therefore much effort to secure dispatch for vessels, approaching that in the ore trade, where ships of 3,000 to 3,500 tons are loaded in a few hours, and at the same time avoid loss in the commercial value of the coal by crushing.

A machine that, in the opinion of coal shippers generally, meets these requirements has been constructed, and is illustrated in the plates on pages 622 and 624. The first view showing the machine discharging into a vessel, and the second view showing the same machine receiving railway cars from the shore.

From an engineering standpoint it is a very novel affair, but it has been given sufficient trial in actual service to demonstrate its entire practicability, and to warrant a statement that it will within another season completely change the method of handling coal on the lakes. Instead of the old system of derricks and buckets this machine takes up a loaded car of about twenty-three tons capacity and dumps its contents into the hold of a vessel in a manner that avoids practically any fall of the coal, as the car is loaded to the mouth of the hatch, and the entire load allowed to slide out in a concentrated mass through an ingeniously-arranged chute. Of



COAL-HANDLING APPARATUS.—THE MCMYLER CAR-DUMPING MACHINE CO., CLEVELAND, OHIO.

course a car of fifty tons capacity could be handled in the same way, and the efficiency of the machine thereby greatly increased. Several records as high as fifteen cars of twenty-three tons each, 345 tons, unloaded in one hour, have been made with the apparatus, and steamers ranging in capacity from 2,000 to 3,100 tons have been loaded in eight to twelve hours.

The machine is entirely self contained and portable, having the features of a revolving derrick, with the addition of a girder or bridge, by means of which the entire car of coal, instead of a loaded bucket, is taken up and discharged. All trestle work is avoided, and there is nothing complicated or expensive about the apparatus. Aside from the machine itself the only expense is that connected with arrangement of the railway on which it moves.

The elements of the machine may be described as a bridge of two plate girders turning on trunnions near the river or dock end of the bridge. These trunnions are mounted on the framework of the house, which is in turn supported on a series of wheels twelve inches diameter, arranged after the manner of a draw-bridge. The circular way on which these wheels move is supported by heavy plate girder framework, and sixteen large car wheels moving on four tracks, the outer ones of which are twenty-four feet apart. Back of the machine and its tracks are six double lines of railway tracks, which are for loaded and unloaded cars, and which are spaced about the same as the hatches of vessels, and perpendicular to the line of dock. The power is furnished by a pair of suitable engines which control the hydraulic power, and all operating parts are controlled by friction clutches, requiring but one operator to handle the entire machine, and only four men in all engaged in connection with the plant. The other three are a fireman, a man employed on the bridge and a man to attach the cable to the draw-head of the car.

A hydraulic ram of $18\frac{3}{4}$ inches in diameter, mounted on trunnions, tilts the bridge, which is so balanced that it rights itself, the ram forming an effective brake for it. From an accumulator, having at one end a hydraulic piston, and at the other a steam piston ten times the area of the hydraulic piston, is taken the pressure to operate the clutches for pumping, hoisting and driving laterally, and also the brake controlling the winding drum that pulls the car up the incline.

In operation, the vessels being placed so that the hatches are opposite the tracks, or nearly so, the machine is moved to the hatch which it is desired to load into, a one and a quarter inch steel cable is hooked into the draw-head of the car, and the car pulled up the upper or shorter end of the bridge, which is so constructed as to form a bumper, against which the end of the car rests when tilted. The end board being withdrawn automatically through the tilting operation, the coal flows out through a discharging chute, and is concentrated in a telescopic trough or spout, which, at the first flow of the coal, may be lowered to within a few feet of the bottom of

the vessel. In double-decked vessels this chute may be lowered to the between-deck combings.

After the carload is discharged the bridge is tilted back, the car returned down and off the incline on to the ways provided for "empties," another loaded car again taken up, and so the operation continues, the machine moving from one set of ways to another, and from one hatch to another, as may be required by supplies of loaded cars, or in trimming the cargo.

Through this latter operation a great saving in time is gained, as shifting a vessel is seldom necessary while the work of loading goes on. Not only can the machine be moved laterally in either direction with a car on the bridge or platform, but it may be swung at the same time to avoid spars or any other obstructions on the vessel. One of the best features of the machine is its adaptability to the kind of railway cars in general use in the bituminous coal trade. The only change required is that of fitting sliding end boards into the cars at a trifling cost.

The capacity of the surface track plant shown in the second engraving, and from which cars are moved on the platform of the machine by a locomotive constantly in attendance, is 140 cars, or about 3,300 tons.

To this description is appended a list of loadings by the machinery that shows 59,794 tons of coal loaded on vessels in 300 hours and 40 minutes, or nearly 200 tons an hour, which far exceeds anything before attained."

A STOCK OF TIMBER.

Passing the other day a timber yard in this City, occupying most of a "block," in a part where land is very valuable and rents high, we stopped to consider and compare the methods with those followed by our friends in the old country.

Here, in this San Francisco yard, were piles upon piles, thousands upon thousands of feet exposed to the sun, covered with dust and grit, stained by rain, piled up at great expense, covering ground the rent of which alone would make a fine income for the timber merchant—what for? To provide sizes, is the only answer that could be imagined. To select bills from stock on hand.

Now in the old world, this same timber merchant, we do not say lumber merchant, because if this is read anywhere outside this country or translated into another tongue, "lumber" would mean trash, or waste material. This same timber merchant we say, would occupy in an European city, one tenth of this area. His "stock" of timber would consist of deals 3×9 , 3×11 , or 3×13

inches. At the front of his timber yard would be some deal "frames," or frame saws, "gangs" to use the technical term, for re-sawing these deals to order.

If timbers having dimensions larger than 3 inches are required they are doubled or trebled. If a long girder 12×12 inches is wanted it is built up, unless a large number are wanted, then they are sawed out from logs, but for all house timber the deal is the unit.

If boards from $\frac{1}{4}$ in. to $1\frac{1}{2}$ in. are wanted, the deal saws are started and the boards are turned out about as fast as they can be hauled away. The surfaces are clean, true and smooth, and the thickness accurate, so no planing is required except for painted surfaces.

The deal saws run at the rate of 300 to 350 strokes per minute, and two deals can be fed through at once, if required. The feed is slow, so as to secure accurate, smooth work, but the speed is made up by the number of saws. Suppose an order comes in for $\frac{1}{2}$ -inch boards, a common thickness for small packing cases, and that two deal frames are set for double stuff of that thickness. There will then be twelve boards coming through the machines, and the order can be filled about as soon as the stuff can be handled. If stud-ding, rafters or the like are wanted, the deals are cut the other way.

The waste of wood is not more than one half as much as here, and there is no yard waste by staining, checking or splitting.

We believe it would be a remunerative business to found such a timber yard here, and furnish builders clean accurate stuff cut to true dimensions.

Mr. Maxim's flying machine has had an airing before the British Association, and various members, including Lord Kelvin, took a great interest in the matter, and joined in a discussion. Professor Osborne Reynolds suggested a condition that applied to all flying machines, which if correct is discouraging. He said that the weight of the materials used in construction must increase as the square of the machine's dimensions, and the weight being as the cube, must increase faster than it is possible to increase the strength. If by dimensions the Professor meant capacity or lifting power, this proposition includes a limit to such contrivances. It is a matter of some astonishment that the learned society should have given the subject of flying machines so much attention with this single mention of the principles that lie at the bottom of aerial flight.

LITERATURE.

A Practical Treatise on the Steam Engine.

BY ARTHUR RIGG.

E. & F. N. Spon, London, and Spon & Chamberlain, New York.

The present is a second edition of a treatise that is favorably known to the majority of our readers concerned in the study or construction of steam engines. A good description of the general character of the work is given by the author in his preface to the first edition, published in 1878. From this we quote :

“The present treatise is written to describe various examples of fixed steam engines, without entering into the wide domain of locomotive or marine practice, to give details of construction, with the principles by which their relative proportions may be calculated, and to investigate the more modern applications of science to the subject. In order to avoid mathematical forms of expression which are unfamiliar to practical men the graphic method of calculation is brought into use, and it will be found that with very little attention a busy engineer can adapt this system to ordinary calculations, for it has the merit of extreme simplicity, and can be employed even where more elaborate systems fail.”

The same remark applies to a preface in the present edition, from which the following is an extract :

“In the first edition of this treatise a very complete essay was given on the most vital point in connection with accelerated speeds, namely the forces developed by reciprocations, and the nature and intensity of the destructive strains produced. In the new edition this chapter has been considerably extended, and the causes of many failures are thereby made clear

Designs, with short descriptions, are given of the more important modern classes of fixed steam engines, and of the best examples of the high-speed class, particularly in their relationship to electric lighting, and triple expansion engines receive their due attention. The elaborate account of slide valves and other details given in the first edition has also been revised and further extended, so as to meet the requirements of a modern and a more exacting perfection.

The aim and object of the author all along has been to bring out *general principles*, which will serve to guide an engineer in the ever-varying requirements of his arduous profession, rather than to accumulate a cyclopædia of disconnected facts, and,

probably, this has been the reason why a treatise written solely for practical engineers has been extensively adopted by students and others, for whom it was not at first arranged.

In revising the original work, and in writing new essays upon vital points connected with steam engines, the same general object has been kept in view, and it has been the author's ambition to explore the avenues of knowledge, not for the purpose of helping the mere copyist, but with the nobler object of leading from a generalization of facts, which alone becomes sound theory, towards that far higher wisdom which governs the ruling of all the works of nature, and guides the application of all knowledge.”

The book is a quarto, containing 380 pages of text, illustrated with numerous diagrams and drawings. The main feature is the plates, 103 in number, occupying nearly the same space as the text, drawn accurately to scale, and constituting an invaluable reference for designers and draughtsmen of steam machinery. Nearly all are original drawings by the author, and taken from the best practice of the time.

The book, compared to most modern treatises on steam, is intensely practical in nature, and by arrangement and indexing is made one of convenient reference for a draughting room or engineer's office. The price is \$10.00.

Correspondence Schools.

We mentioned last month the receipt of a number of publications relating to the “Correspondence Schools,” at Scranton, Pa., among these, and of most interest, are a large number of letters, nearly two hundred, written by students in respect to their experience and opinions of the system. It is the most original agency for technical education that has ever been devised, capable of an extension that has no visible limit, and portends a time when we will not set off a few of the most fortunate for education, but educate all up to the limits required in the application of the skilled arts. One effect will be to raise the standard of the ordinary courses in technical colleges and schools, because mediocrity can be attained

at a tithe of the expense and in ways more congenial to most students.

The habit of writing out exercises is a good one, good in all kinds of mnemonic effort, and when to this is added the interest of a communication personally addressed, and the environment of a home, it is easy to discern the attraction of a correspondence system.

Among the papers mentioned is one sheet of examples in hydraulics that as a collection of educational problems is the best we have ever seen. When a set school book is done, and the plates made, there is an end, but in the present system a tentative course is possible. Change and improvement can go on continually; not only this, the problems submitted can be nicely graded to the requirement and capacity of the student, and can, by the facility for change, be made relevant to particular examples or practice.

Internal Work of the Wind.

We are favored by Prof. S. P. Langley, of the Smithsonian Institution, with a copy of his late treatise under the above head, which is relevant, but by no means clear until the nature of the propositions are explained.

The fact is, we have not in our redundant vocabulary any suitable term to convey the idea represented by the word "internal" as above employed. The sense here is "within itself," or by itself, most nearly expressed in the Latin affix *auto*. Reduced to the most simple terms Prof. Langley's essay relates to the work that is, or may be, done by the variation of wind currents, and attempts in a most wonderful manner to account for the soaring flight of birds on this theory.

Prof. Langley, almost by accident, discovered that the record of a sensitive anemometer would show that the wind was extremely irregular, a series of pulsations illustrated here by diagrams, and capable, as Prof. Langley thinks, taken in connection with the inertia of a body suspended in the air, to account for the dynamic forces of sustentation. This certainly seems at first thought to be an impossible condition, but it is here fortified by graphic and other data that in the absence of any other theory is deserving of serious attention.

In one diagram, plotted at Washington last year, the velocity of the wind was taken at every five revolutions of the anemometer, varying in one case, during a period of about ten minutes, from ten to thirty-one miles an hour. In another case varying in about twenty minutes from seventeen to forty-eight miles an hour. Between these points were various erratic readings, such as no one would expect or consider possible.

Scientific observers have for a long time past felt a rebuke in the fact that the soaring flight of birds, when the wings did not move, was not explainable on any understood principle of physical laws, and if the present theory proves an explanation, it will be a creditable discovery for Prof. Langley.

Induction Coils and Coil Making.

BY F. C. ALLSOP.

Messrs. Spon & Chamberlain, the publishers, send a copy of the above work, which is in a sense a companion to other practical treatises of the kind or class by the same author, on telephones, electric bells, and electric light fitting, constituting almost the only books that give explicit instructions in the manner of making as well as operating electrical apparatus.

It is remarkable that anyone, who must have spent most of his lifetime in learning the constructive arts, should at the same time master the theory and principles of electric science, and acquire the power of writing lucid descriptions of the work as the author has here done. The diction is that of the laboratory, the subject is of the workshop.

Coils and induction constitute the mysterious element in electrical apparatus, that one which must always form a principal impediment to popular understanding of the phenomena that attend on this subtle form of energy, and in no way can the nature of induction be taught so successfully as through the construction and arrangement of coils.

It was a novel and, at the same time, a happy idea to set it off as a subject for separate treatment in the manner here done. The book contains one hundred and sixty pages, over one hundred illustrations, and is sold for \$1.25.

LOCAL NOTES.

We have seen some good work on marine and other engines, both in this and other countries, but have never seen better than is done on the machinery of the war ships constructed at the Union Iron Works. No one not a practical fitter and steam engineer can understand just what the term good work implies. It is shown in a hundred ways that are not describable. If an experienced constructor of machinery is taken to an engine, and glances over it, he receives instantly an impression of the quality of the workmanship. The symmetry of shapes, the trimming of corners, the surfaces of bright work, the position and curves of pipes, and, above all, harmony of the whole is taken in the mind like a photograph. The fitting of moving surfaces are, of course, hid in most places, and cannot be seen, but are understood from the rest. The engines, main and auxiliary, of the *Olympia* are, we imagine, the finest possessed by the United States Navy.

It must have been with some regret that the Union Iron Works after finishing this fine ship, excepting her armor, were compelled, by a change of her armament, to cut, tear down and alter not only the cabins but a good deal of the metal work. Alterations of the kind are a serious matter, when hundreds of electric wires, speaking tubes, pipes, motion rods, and so on, are built in, and concealed in every part. By the way, the cabins of a war vessel are a curiosity. The captain and admiral cannot dine together, because there is a difference of rank, they must have different dining rooms, pantrys, and a separate establishment. The line and staff must have different quarters, and messes quite distinct. Then again the warrant officers, the gunner and carpenter, must have separate cabins and outfit to keep the rank distinct. These last are expert officers that hold commission by "warrant." It is a little empire, having all the attributes of a monarchy with its grades and rank, perhaps necessary, perhaps not.

The *Oregon*, in her several runs about the Bay, has performed in a most satisfactory manner. There was no heating, or mishaps of any kind, everything worked to a charm. The *Olympia*, the model ship of the Navy, now lies at Government expense waiting for her

armor. The engines have to be turned a quarter revolution each day, lights maintained, the ship kept clean, and her moorings looked after, at no inconsiderable cost to the Government, and at a cost to the Union Iron Works also, because to haul off and wait when a ship is nearly finished greatly increases the amount of work to be done. The making of armor plates has not succeeded so well as shipbuilding. It may be more difficult in one sense, but is infinitely less complex in another sense. The treatment of large masses of metal is comparatively a new art in this country.

The deplorable condition of our streets and sewers is well known to the public. The results of the past administrations of the Street Department is before us, or rather is all over, within, and around us, and it is now time to provide competent engineering supervision for public works, to which the people are certainly entitled. The following is a list of Superintendents of Streets, and their occupations, for the last thirty years :

1893-94	W. W. Ackerson	Building Contractor.
1891-92	Jas. Gilleran	Hotel Keeper (Iron Moulder).
1887-91	Thos. Ashworth	Real Estate Dealer (Capitalist).
1886	Wm. Patterson	Custom House Inspector.
1885	C. S. Ruggles	Clerk.
1883-84	T. J. Lowney	Blacksmith and Carriage Manufacturer.
1881-82	R. J. Graham	Teamster.
1880-81	Wm. Patterson	Custom House Inspector.
1878-79	L. M. Manzer	Custom House Inspector.
1876-77	John Hagan	Marble Cutter.
1874-75	S. H. Kent	Shipbuilder.
1871-74	S. J. Ashley	Bricklayer.
1869-70	M. C. Smith	Law Student (?)
1865-69	Geo. Coffran	Bricklayer, Contractor and Builder.
1863-64	Geo. T. Bohen	Undertaker.

Under the above Superintendents of Streets about \$29,500,000 have been expended. Of this amount in 1887-88, \$920,051.67; in 1888-89, \$1,138,526.77½; in 1889-90, \$1,348,877.09; in 1890-91, \$1,671,070.21; in 1891-92, \$1,715,816.36; in 1892-93, \$1,448,768.06. This expenditure has been incurred for street and sewer work, which should all have been done under the direction of civil engineers.

The Vulcan Iron Works are reconstructing the saw mills of the Alaska Treadwell Mining Company that were burned down some time ago. The new mill will have a capacity of 30,000 feet a day, and must far exceed the requirements of the company, but there is

a considerable market at Sitka, so the mill need not be idle. The Vulcan Company are also constructing a new plant for the California Petroleum and Asphalt Company, near Carpenteria, in Santa Barbara County. The machinery includes large drums of wrought iron, six feet or more in diameter, mounted on trunnions like a scouring barrel. The reduction or cleansing of the pitch has proved a problem of much difficulty, but the operations have for some time past been quite successful, and the business has assumed a very prominent character. There are bituminous deposits around Ventura, and elsewhere in the southern counties, so the industry may be much expanded in future.

Mr. Dunn's article on transportation in this number, which we trust will be read by all those who receive the Journal, suggests and shows the intricacy of great economic causes, and shows too, in a conclusive manner, how little we study the conditions of useful industry. We have contended that the truths of economics would never appear in any form to command confidence until the study of them was conducted on the same methods applied to physical science. Every year the philosophy of industry is more dealt with by science and mathematics, and one may well ask, how else can such things be dealt with? Any other method produces "opinions," and as these are warped by personal interest in most cases, they form no basis of truth. If, for example, Mr. Dunn can, by exact methods, determine the components that enter into a box of California peaches delivered at New York, then some reliable inferences can be drawn. Without these quantities there could be only opinions.

The reported mutilation, or alteration, of California Court Reports by the defendants in the Oakland Water Front cases before the Superior Court, is the most extraordinary proceeding of the kind on record. It is a grave crime against organized law and justice, a miserable and criminal trick that should determine the case against the defendants, who are in fact the Southern Pacific Company. The facility with which the matter has been dropped leads one to suppose the charge may not be true. If it is, and the people care no more for such a crime than to forget it in two weeks, we are far on the road to anarchy, or an end of all law. The cause eliminated related to the alienation of lands by the State, and is determinate, in so far as it forms a precedent, for the "water front" case.

Captain Matthew Turner is building at his shipyard, in Benicia, a new floating dock for the California Dry Dock Company, of this City. It is to receive vessels to 2,500 tons, is 301 feet in length over all, 10 feet deep under the deck, and 36 feet over the pontoons. It will be constructed of timber, fastened in the most substantial manner, and will contain 1,500,000 feet of timber. The iron work for fastenings and stays will weigh over 100 tons. Captain Turner is well prepared for such an undertaking, and is a trustworthy contractor on all kinds of work pertaining to the sea. The dock is to be sheathed with non-corrosive metal, of which 23 tons will be used, and the whole is to be ready in February next. The dock will probably take the place of one of the two the company have now in use on the City Front.

The dock above named will, no doubt, be complete in all of its hoisting qualities, but is to be fitted up with a battery of piston pumps of a ramshackle nature that will conjointly do about as much work as one centrifugal pump that would cost less than half as much, and be one half the weight. This is a most extraordinary circumstance, and on learning of it we visited and examined a similar dock fitted with such pumps, and found precisely what was expected. A row of spur wheels and reciprocating gearing, braced, patched, and evidently calling for as much attention in a month as a centrifugal pumping plant would in years. In another place in the present issue will be found some information bearing on this matter. The only objection to centrifugal pumping that could be ascertained was that such pumps would not drain a sump and restart, but if arranged for the purpose they will do both.

From the *Engineer*, New York, we learn that the Magnolia Metal Company have purchased advertising space in some trade journals, and then sent some kind of a political advertisement to fill such space. This is cool, to say the least. We are not likely to be called upon by the Magnolia Company, but are perfectly willing to accept an order, and try in the Courts of California a refusal of not only political but irrelevant matter of any kind. The subject matter forms a part of all contracts for advertising, with journals of any standing at least, and no one in that category should accept such advertisements on any terms. We published, some time ago, an analysis of "Magnolia" metal, made in the laboratory of the

Pennsylvania Railway Company, at Altona, Pa., which brought out a significant letter from the office at New York, and in reply an offer on our part to, if required, repeat the analysis here if that of Prof. Duncan, above referred to, was not considered good authority.

In the articles on centrifugal pumps, in this and preceeding numbers, it has been thought necessary to doubt the value of computations respecting what may be called the hydraulic action of such pumps, but the fault is much wider than is here complained of, and seems to extend to most machines of the hydraulic class. In the *Encyclopædia Britannica*, under the head of Hydrodynamics, Vol. XII, Page 533, in the article on Hydraulic Rams, is the following :

“The discharge valve *d* is of greater weight than the statical “pressure on its under side. When, therefore, the water is at rest “in the supply pipe this valve opens.”

The author wisely refrains from giving formula for the forces and quantities involved. His views are those commonly met with in “ram literature.” The proposition is not only not true, but is absurd. The weight of the valve bears no such relation to the static pressure beneath it, and is commonly not one half as much, and sometimes not one fourth as much, as can be seen by examining any ram in use.

The present state of political parties in this country portends some progress toward a dissolution of the whole system. The struggle for offices has become so intense as to derange party organization, and, like the rout of a Chinese army, everyone is for himself. This may, and we hope does, warrant one of our most prominent engineers in permitting his name to be presented as a candidate for a municipal office, an engineering one in fact, but degraded to the level of the spoils system for a long period in the past. It is a great responsibility, this violation of the ethics of the profession, which has, all over the world, kept singularly free from the scandals that attach to administrative public offices. No one ever selects an engineer as the villian of a romance or play, and it is seldom that anyone of the profession is accused of roguery.

The prosperous and beautiful town of San Mateo, a suburb of San Francisco, was recently incorporated, and Mr. G. W. Dickie, Manager of the Union Iron Works, a resident of San Mateo, was elected one of the trustees. As soon as the Board was organized

Mr. Dickie, as a man of business, offered a resolution respecting some required improvement, and was informed by the legal advisor to the Board that this course was irregular, and the Board must proceed by "ordinance" for any executive work. "Ordinance," said Mr. Dickie, "Why I have been for five years contending with the 'Ordinance Bureau,' and here is the same impediment to be dealt with." The force of this joke will be understood when it is considered that in building war vessels there is always more or less difficulty, commonly more, in adaptations to meet the views of the ordinance officers. Those who know Mr. Dickie's habits of dry humor can imagine the effect of his protest.

About one half of the flour mills in California are closed, and the rest, it is presumed, are to earn enough to cover all the invested capital. This must be to maintain the price of flour above that of wheat and the cost of manufacture. South of us, and in near connection, are millions of people who have no flour, half of them rarely eating white bread, still it is taxed beyond possible purchase, and trade is thus destroyed. We are not in a position to complain, because our own national revenue is raised in the same manner, and we are building "commerce destroyers," but it is hard on California, which is the especial victim of nearly all the contrivances to hinder commerce. We are getting down close to a "struggle for existence" when one half of the most important and permanent industries of the State are suspended.

Messrs. Adam Schilling & Sons, of this City, makers of gas engines, have been fitting some launches with their engines arranged in a novel manner. Two cylinders are set nearly opposite and athwartship, so arranged that the motion and strains are opposite and coincident so there is a complete balance and no vibration whatever. The disturbance caused by unbalanced reciprocating weight has compelled the use of vertical engines for launches and boats, or at least this has been one of the main reasons for vertical engines in all kinds of vessels. Whatever advantages there are in horizontal engines are attainable by the arrangement above named. From drawings of a boat and engines, sent in by the firm above named, there appears to be very convenient and compact arrangement, with the weight so disposed as to give a good meta-centric stability, which is quite an object, especially with boats of narrow beam.

COMMENTS.

The "commerce destroyers" which four years ago we denounced as a disgrace to our navy, in name and purpose, are thus spoken of by Mr. Edward Atkinson, in the *Forum*, for September :

"Three naval vessels of a new type have lately been tested for their speed. They cost \$3,000,000 each. It costs \$800,000 a year to maintain them. What are they good for? Nothing. What are they bad for? Everything. They are worthless even as cruisers, because they can carry but little coal. They are worthless even as battle-ships, because their armor is light. They are worthless for defence in our harbors. Their very name is a disgrace. They are called 'commerce destroyers.' Their cost was about as great as the whole endowment of Harvard University. The annual cost of maintaining three of this vile type of piratical destroyers is more than the annual expenditure of Harvard University for all its beneficent services."

In the letters written by various manufacturers to the Senate Committee on Finance, there is tolerable unanimity of opinion, that the articles on which a high duty should be placed are those produced in this country, and that commodities not produced here should bear little or no tax. On the assumption that a tariff is to produce revenue, this is wrong, because of discriminating between home industries and causing disturbance. This is the theory of tariff taxation in England where the subject has been studied more carefully than anywhere else. There are nineteen articles that pay import tax there, the principle ones being, beer, spirits, chickory, cocoa, coffee, chloroform, ether, tea, tobacco, wines, cards and naphtha. None of these things except spirits, beer and cards are produced in the United Kingdom, hence are considered proper articles for taxation and revenue. It will be seen that they are mostly luxuries.

The building of an immense steel works at Youngstown, Ohio, now nearing completion, is a vagary of investment, or is the destruction of a like capacity in older and less complete plants elsewhere. The cessation and sale under execution of several large steel works during a few months past, the Otis works at Cleveland idle, and prices at a point that renders existence a problem, are hardly circumstances to warrant an investment such as will be

involved in the Ohio steel works above named. It is time now to consider whether the stimulus imparted by a high tariff and a steel rail trust, down to four years ago, is not to be compensated by a loss of great magnitude. Such loss is to a great extent inevitable by reason of the improvements in processes, and obsolete plant that can not be replaced by earnings. The difficulty comes from what may be called a "boom capacity." No one will question the judgment of iron men in such a center as Youngstown, but many will wonder who is to make room for the product of the new works.

The *Iron Age* in a late issue has an article on the Government as a purchaser, and claims that contractors are treated as rascals, and Government work is not desirable for that reason. The proposition does not apply out here. The Government seems to treat the contractors very fairly so far as regulations will permit, and in so far as war material, which is the subject especially referred to, but the wonder is that any fair treatment is expected. It is a common understanding not confined to this Coast as we had supposed, that the Government is to be cheated whenever possible. Some people have here recently furnished the Government with ground to build a post office on, for the sum of \$1,250,000 which no one considered worth one half as much to any other purchaser. The matter was investigated by both Government and private officials, but it did no good, the money was paid. An honest contractor has to work under the odium of such things and must, however deserving, make his way through traps set to catch rascals. The distrust of contractors is not however always present. Those who confirmed the San Francisco post-office site at a million and a quarter of dollars would have passed any kind of war material.

A recent letter written to the editor of the *American Machinist* by "Piece Work" breaths the spirit of that system, or what goes by that name, a bargaining, "beat the boss" kind of idea, farther than time work from true piece work. It contains no idea or thought of workmen producing one element in a responsible and dignified way, while the owner contributes the other elements as in contract work or estimate work. It is the old idea of "serving a master" and paternal regard for the laborer. Bad work, inspectors and foremen to dodge—"treating men as machines," do all they could for

the master, and the like ; but of coöperation, mutual dependence and responsibility, nothing. Private or personal contracts in a works, such as are here referred to, are unfair, demoralizing and undemocratic. Every one should share in the profits of piece work where it is introduced, and everyone be responsible for all the work contracted, or else none.

Sir Henry Bessemer, who is now 84 years old, has written for the *Engineering Review*, an article on Bessemer steel, which is very interesting, but open to the criticism that he claims the whole art of making such steel as his own personal invention, which, if we are correctly informed, is not quite the case. When the manufacture of convertor steel was young, some of the essential features of success were furnished by others. The admixture of spiegeleisen, for one thing, was the invention of some one else, but no one feels like contending with a man who has been foremost in this art, and done so much for the world. He says that the Bessemer steel made now in one year would make a column of 100 feet in diameter, 6,684 feet, or one and a third miles, high, and that if in a wall 100 miles long it would be 20 feet high and 5 feet thick ; also that one week's product would make a column 40 feet in diameter, 803 feet high, and that the product of one hour would make a column 8 feet diameter, 139 feet high.

ENGINEERING NOTES.

About two years ago there went the rounds of the technical press, rival results in turning plain shafting. The figures sent in came from various people and works in this and other countries, and are not now remembered, but we will undertake to claim that twenty-five per cent. can be added to the largest amount reported, by shops here in San Francisco. This is an assumption of our own, based on some observations made recently, and may include straightness, smoothness and accuracy of gauge or diameter. Since the Luath patent in cold rolling, and we may say for forty years before, or for eighty years past, there has been no notable improvement in turning and preparing shafting bars. Speed has in some cases been increased, but commonly with a proportionate loss in quality or condition of the bars when done ; want of straightness has been a principal fault.

We always believed that the Luath process of cold rolling shaft bars as developed by Messrs. Jones and Laughlins, of Pittsburgh, Pennsylvania., was at fault and incomplete, because the treatment was not uniform. The inaccuracy of hot rolling, which is a good deal, had to be corrected in the cold process, and this resulted in more or less condensation and consequent variation of inherent strains, or disturbance of molecular structure in the bars. It also made cross or tangential rolling necessary, because the intense pressure required to reduce the bars could not be produced by parallel rolling. There was also a fault, and a serious one, of rolling the oxidized surfaces into the bar. The scale was removed by pickling, but the rough surfaces remained to be leveled down by pressure. It was a half-way process highly important and useful, but incomplete, as is proved by the fact that it has not spread about as it naturally should have done if the result was perfect.

The ideal process, to so call it, for preparing finished rods or bars, consists of various operations that are now carried on, but not combined. Special lathes for turning with "die" tools, the grinding process seen in various works in New England; cold rolling by the Luath method, parallel rolling to straighten the bars and condense the surfaces, and special rolling of bars at a low heat comprehend all that is likely to be discovered, but each of these has been attempted as a method by itself independently, none have really succeeded, except plain turning with tools. The fact is that except by "drawing" after the manner in which wire is made, the manufacture of finished rods or bars is not in a very advanced stage or at that point that may be expected at some time in future when it becomes a distinctive branch and does not include couplings, bearings, pulleys, wheels and so on. These have nothing in common with the processes we have been discussing. The most successful way of preparing such rods or bars is to remove the scale by "pickling," which is a cheap process, then turning through tool dies to a true size, rolling with parallel rollers, and finally straightening if required.

Mr. George S. Strong, some of whose designs in steam engineering have been illustrated in this Journal, prepared plans for some large steam boilers for the Brooklyn, New York, water works, that are deserving of note. They are internally fired, having two large

furnace flues on the Lancashire method and return tubes to a breeching in front, but the arrangement of the flues is inverted, the furnace flues being on top and the return flues below. Eighty per cent. of steam is generated around the furnace flues, and there is no good reason why this steam should find its way up through several staggered tiers of return tubes. The idea is thoroughly logical, and the results prove its correctness. The boilers are 9 feet in diameter and 22 feet long, contain 6,000 pounds of water, and evaporate 10,000 pounds of water per hour at the rate of 11 pounds of coal for each horse-power. The boilers were constructed by the Edgemoor Iron Company, at Wilmington, Delaware, and we imagine are by no means the last that will be made on the same method.

We note that makers of water wheels in the Eastern States have turned their attention to impulse wheels, and have, in one case at least, adopted a dividing wedge or rim with buckets at each side. This is an old expedient on this Coast, and may do where water is plenty. The dividing edge has been made here of steel, and finished to avoid surface friction, but even then lowered efficiency. We imagine, however, that wetted or flowing surface need not be taken into account when "cored-out" buckets are good enough. This stage of impulse water-wheel practice is twenty years old on this Coast, which is now near the point where the whole of the contact surfaces of the buckets will have to be geometrically true and smooth. This is one requirement of Commodore Meville in considering such wheels as a means of distributing power on war vessels.

The *Priscilla*, a new steamer for the Fall River Line, from New York, through the Sound, forming as it were the first night of travel to New England, is without doubt the finest steamboat for inland waters ever constructed. She has accommodation for 1,500 passengers, is 440 feet long, 8,500 horse power, and cost \$1,500,000. The engines are inclined, and have initial cylinders 51 inches diameter, and low-pressure cylinders 85 inches diameter. The wheels are feathering, 35 feet in diameter, 14 feet face, or length of floats. The voyages of this steamer, 181 miles, are made in about ten hours, or 18.1 miles an hour, but this could if required be much exceeded. The *Priscilla* is a distinct departure in several respects from former boats in the line, and in new features tends toward ar-

ocean liner, except as to paddle wheels, which we presume are adopted because of the draught which must for this trade be kept within a limit that will not permit screws or the form of hull that screws demand.

Mr. Cogswell, of Syracuse, has sold his racing yacht, the *Fieseen*, to the Brazilian Government, and was no doubt glad of the opportunity. When one constructs such a boat and drives it a few times up to or beyond the expected speed, their interest wanes and some new field of exploit is sought out. The *Fieseen* was constructed by Mr. C. D. Mosher, of New York, and has a record of $31\frac{1}{2}$ miles an hour, which exceeds so far as we know all other boats of the kind. She is 85 feet long, 9 feet 8 inches beam, 42 inches draught, and is driven by 600 horse power. The game is not done however. We venture the prediction that greater speeds will be attained by sliding machines. For example, Mr. Maxim's flying apparatus fitted for skimming over the water might go 50 miles an hour, and it is a pity his efforts were not directed in this line.

The widest divergence in steam-engine practice that has ever existed between this country and Europe is in the matter of automatic and throttling regulation. Nearly every directly-connected engine made in this country for dynamo driving is of the automatic type, and nearly every one made in Europe is throttling. The safest conclusion is, perhaps, that either way is right, or is suitable. The failure to follow the automatic method by European makers permits a reasonable doubt of its accredited value in relative steam economy. We are speaking of single-valve engines especially. There is something here to be explained, and a fair critical review of the matter by some one competent to deal with it would be read with interest by steam engineers, and be useful in a high degree. That there is loss in varying the point of cut-off and range of expansion with the load or resistance is obvious, and that there is also loss by condensation when the general pressure and temperature changes with the load is also obvious.

A contemporary says Joule's mechanical equivalent of heat brought forth the compound engine. We beg to differ with the proposition. Steam-engine makers brought forth the compound engine, and it has kept the "thermo-dynamic" man in hot chase to explain the engine as fast as it developed itself in the hands of

mechanics. They are now behind, or at least a constructor of our time, if he set out to make a first-class steam engine, would, perhaps, not refer to books for the proportions and nature of the mechanism at least. He might in proportioning the cylinders call in scientific aid, and would stop there. What he would do would be to ransack the practice of others, and all the "results" he could find. The qualifications of a practical designer of steam engines, or other machinery, come, at this time, from wide observation, experience and the power of intelligent selection.

ELECTRICITY.

NOTES.

The Siemens & Halske Electrical Works, at Chicago, were burned on the first of August, causing a loss of half a million of dollars. There were on hand finished dynamos amounting to 9,000 horse power, and a large amount of contracted work. The tools lost are estimated at \$250,000. They at once occupied the Grant Locomotive Works, and went on rapidly to reproduce the machinery burned. The firm will be in no way affected. Half a million dollars will not disturb Siemens & Halske, who employ a very large capital in their business. Other firms suffered at the same time. Messrs. Wells, French & Co., makers of car springs, lost \$100,000 worth of property in the same fire. The losses by fire in manufacturing establishments have been unusually large this year, and have advanced insurance rates, which is most unfortunate in the present state of trade.

There is a rumor that the Canadian Pacific Railway Company intend to haul their trains over the mountain passes by electric motors. The scheme has a strong flavor of the practical in it. The wires in mountain districts would form no objection, and there is power at hand on all sides. The distances are not great, that is, the distance from available power on any of the mountain passes need not exceed limits now attained in electric transmission. The American lines, most of them, have coal convenient to the mountain divisions, but the Canadian line, we believe, is not so fortunate, and this spring, for the first time, seems to have been overcome by natural obstacles such as human ingenuity could not combat, the enormous floods on the western slope. Electric propulsion would not help this, except as to being independent of fuel.

Lieut. F. J. Patten has, in the *Railway World*, commenced a series of articles on the electric-conduit systems for railways, and presents diagrams of various notable methods. He says that more than five hundred patents have been granted on such devices, and naively remarks that the supply of schemes is out of all proportion to the demand. From the first article, and the devices therein shown and discussed, one must conclude that the impediments are very nearly in proportion to the number of schemes to overcome them. The first and main fact to be noted is that the cost of any conduit system must be far in excess of an overhead or accumulator one, and there is no likelihood of their adoption so long as bare overhead wires are permitted to be erected in the streets of cities. The oldest conduit line is at Blackpool, in England, built nine years ago, and has been worked successfully ever since.

Mr. Tesla is happy in his methods of illustration, as witness the following from a reported conversation with him :

"Voltage is speed pressure at a given point. It wouldn't do you any more harm to have a needle shot through your arm very rapidly—that is to say, with high voltage—than it would to put it through slowly. In fact, if it hurt you at all, the slow operation would probably hurt more than the other. The question of danger is simply the size of current, and yet if a big enough current should be turned against you and broken with sufficient rapidity—if it should, so to speak, jerk back and forth an inconceivable number of times to the second—it wouldn't kill you. Whereas, if applied continuously, it would simply burn you up."

MINING.

NOTES.

Bauxite, the present source of aluminium, was not known until twenty-five years ago, that is, was not regularly mined. Chemically it is the triple hydrate of aluminium. The name comes from the place it was first found, in 1821, at "Baux," in France. Now it is found almost everywhere, or at least in most all countries. In this country the principal mines are in Alabama and Georgia. This far the ore is dug out of pits, being soft enough to not require blasting. It is selected or picked and dried for shipment. The only pure aluminium made in this country is at Pittsburgh; at other places

alloys are produced. The principal use at this time is to mix with steel in making castings, and for hollow ware, cooking and other kinds. It is suggested in *Mineral Industry*, from which these notes are taken, that aluminium should be used instead of copper for small coins, being light, noncorrosive, and possessing all required and desirable qualities for that purpose.

Smelting sulphide ores by means of the sulphur and iron they contain seems a strange process, but is feasible without other fuel, except in starting. Furnaces are now made to act in this manner, and the capacity is increased by so much as the volume of the fuel usually supplied, and to a greater extent, it is claimed. The process renders roasting unnecessary, indeed roasting would burn out the fuel, and prevent the "pyritic" process, as it is called. The process is applied to copper smelting, but can, no doubt, be employed for any ore containing sulphur and iron. The many ways, chemical, mechanical, and by heat, of extracting metals, especially gold, are confusing unless we at the same time consider the variety of substances with which metals combine. Gold, it seems, is found in all kinds of stone, in the sea sand, and even in sea water, and, as one may say, all over the world.

The English Mountain Mine, at Emigrant Gap, Cal., which has lain a long time as worked out, or worked below pay grade, has taken a new and promising lease of life under a Mr. Howard, who came out from the East in the interest of the shareholders. The Vulcan Iron Works, in this City, are constructing a 3,000-foot ropeway for the mine, and new mill machinery is to be supplied. The property is on a wholly new basis, and the circumstances, as reported in respect to the ore, are not creditable to people familiar with the mine before Mr. Howard assumed charge. There is always reasonable doubt in respect to any mine where the ore sinks below a paying grade. People are easily discouraged, and in many cases unable to follow through low grade ore. The irregularity of quality, even in the best mines, shows how a mistake can be made.

The rise of fifteen per cent., or more, in the price of silver during last month is as difficult to account for as the decline has been. The fact is that commercial matters are a mystery, because always

regarded as one, and if a financial law is discovered no one has any confidence in it. This rise in silver is, no doubt, in some way not explainable, caused by the war in Asia, but the chances are it is permanent. One thing is certain, it did not come by legislation, which commonly acts just the reverse of what is intended. It is claimed that at seventy cents an ounce many of the silver mines will resume work, and it is a question whether if such a consummation was reached the "enemies of silver," will not be the first to rejoice and the most vigorous to promote such a rise. We do not mean scheming bankers and brokers, but the considerate people who have opposed the attempt to raise the price of silver by law.

MISCELLANEOUS NOTES.

The E. W. Bliss Co., of Brooklyn, New York, makers of presses and sheet-metal working machinery and implements, are sending a large share of their product to Europe, which means that they understand their business, and have pushed it in design and functions beyond their foreign competitors. The company are, no doubt, the most progressive in their business of any in the world. Orders are delivered, or now in hand, for Switzerland, Germany, France and Austria, and the company have no use for a protective tariff on their products. A similar foreign sale of American implements of various kinds is possible, even at the present cost of producing in this country, but there is an impression almost everywhere that the price of American tools and machinery is enhanced in the same degree that import duty is assessed, and this must be true by any logic that a foreign buyer can arrive at. We have discussed this in foreign countries enough to know the fact.

The Tehautepec railway has been under construction for forty years. It is one hundred and ninety miles long, from Coatzacoalcos, on the Atlantic side, to Salinas Cruz, on the Pacific side. If operated in a thorough manner, and independent of coalitions and combinations, it could be made the most valuable property of the kind in the world. It has been claimed that the Mexican Government will retain control of the line, and make it free to the commerce of the world. This they will do if that seems the most profitable way, and not otherwise. Nations are like people, and the

policy of President Diaz and his advisers may not be continued under another administration. The route to the East from here is much shorter than by the way of Panama or Nicaragua, enough to compensate for the longer railway portage, and the harbors, it is claimed, are not difficult to prepare and maintain.

Nicholas Longworth, of Cincinnati, who introduced the Catawba wine industry there about fifty years ago, had a difficult experience in his undertaking. He procured vines from all parts of Europe, bringing sometimes as many as 6,000 at a time of various kinds, all of which failed. His last attempt at importation was 7,000 vines from Sura, in France, about twenty varieties that grow high upon the mountains. These grew, but after five years were all dug up and abandoned. He then began to experiment with indigenous vines, eighty-three varieties, afterwards reduced to twelve, and finally to one, the Catawba, a vine found growing on the Catawba River, in North Carolina. In this variety, after twenty years of experiment, was found the thing sought for, and the result is sparkling Catawba wine, one of the finest of its class in the world. There are several kinds; still, sparkling and dry Catawba, also Isabella wines, made at Cincinnati, and in the region about there. It is strange that on the Kelley Islands, out in Lake Erie, there is quite a viticultural interest, mainly table grapes, that could not survive on the adjacent main land.

Large holdings of land for many reasons, some of them explainable, others not, are a curse to this and other countries. It is the base of feudal relation between people, and is set about with some kind of fatal conditions that lead on to inequality and injustice. We have just driven one hundred and fifty miles or so over the country, and had no difficulty in picking out from appearances the large landholdings. The poverty and disorder of people, dwellings, fences, and everything on such estates, and the reverse in all cases when the land was subdivided. The "Code Napoleon," which subdivided France into innumerable small holdings, it was prophesied would ruin the country. It has not done so, on the contrary has been a great benefit. It has cemented and strengthened the nation every way. No man should own or control land he cannot himself till or use. It is not just or expedient.

Among new inventions is noted a metal carriage, and why not? Bicycles are made of steel, so is almost everything else subjected to rough use and strains. There is one problem, that of wheels. A metallic wheel capable of flexure, as all wheel must be, would perhaps fail, but the rim or felloe is all that requires elasticity, and this could be of wood. As to all the rest it could certainly be of metal. Not perhaps in the present form, or even in close imitation, but carried out in respect to the nature of the material. One after another among structures and implements have become iron, from steam and sailing ships down to plows and pails, and there is never turning backward, only progress forward, more iron and less wood. Iron wagons have been made here in California, and did well, especially in the torrid districts where wood shrunk and "came away."

In the London *Times* recently there was a rebuking article on modern methods of dishonesty, containing the following paragraph:

"It is idle cant to pretend anxiety for the better distribution of wealth until we can devise means by which this preying upon people of small incomes can be put a stop to. It is idle to prate of thrift when the small investor has no guarantee whatever for the most ordinary honesty and sagacity in the conduct of his affairs. If we are to admit the mass of the nation to a share in the lucrative business now carried on by men of capital, and there is no other way to equalize wealth without sapping the foundations of industry, we must find some cure for this collective recklessness or dishonesty, which is the curse of joint-stock enterprise."

The works of Messrs. Platt Bros., at Oldham, England, are remarkable. They are devoted exclusively to making cotton machinery, and being situated in the center of the principal manufacturing district in the world naturally have been expanded to enormous dimensions. The works occupy fifty-five acres of ground, a greater part of which is covered by permanent buildings. There are over 9,000 employed men, and besides these a large number elsewhere in the service of the firm. The business was founded seventy-five years ago, and has ever since been mainly in the hands of the Platt family, Mr. S. R. Platt being now the Chairman of the Board of Directors. The plant is continually being extended, and is the home, so to speak, of thousands of skilled men who have spent their lives, and expect to remain there, because there would be nothing gained by going elsewhere.

The White Star and other lines have reduced the steerage rate between New York and Liverpool to ten dollars, and have thereby set up a new difficulty for those who contend that a tariff keeps up wages, and that wages in Europe are at a pauper rate. As there is no duty on labor or laborers what is to hinder them from working on either side of the Atlantic as they may choose? As a matter of fact the wages of this country are better understood in England than here, so also the price of what wages have to purchase. One can go into the headquarters of any trade union in Great Britain and learn the rate of wages all over the United States in the same trade, also the cost of living and the expense of coming here, information not easy to procure at home.

The rates of passage to South American ports from New York are outrageously dear. From Callao to San Francisco, 5,700 miles, the fare is \$120, but from New York to Callao, 3,362 miles, is \$167. To Valpariso from New York, via the Isthmus, 4,633 miles, is \$225, while to Liverpool by British steamers, 3,500 miles, is only \$60, so it is much cheaper if one wants to reach a South American port to go to England, and then from there by the Liverpool lines. The rates on the Pacific side are more than twice as much as on the Atlantic side. If one is in Buenos Ayres the cheapest way is to go to England, and come back from there to New York. This is a fine way of building up commerce with the South American ports. U. S. Consul Jastreniski, at Callao, has written to the State Department at Washington giving a list of rates as above.

It is amusing to learn from our contemporaries that the Bombay mills are ruining the cotton industry of England. It may be that in a class of labor where skill does not much modify the product of a man's work, a cheap rate of labor in India may depress the price of cotton products, but in so far as England the effect will not be serious. The Bombay mills belong in England, and their revenue goes there. If less cotton spinning and weaving is done in England there will be proportionally more of something else done. The danger applies to a command that Indian production may give Great Britain over other countries, this one included. At the present time they manage to pay cotton-mill hands in Lancashire as much, or indeed more, than the same work people can earn in Massachusetts, so there is, no doubt, some margin for reduction.



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THE PERSON AND THE PUBLIC.

In considering the social and moral conditions of our time, the disorder and disturbance that exist in a greater degree than at any other period of the world's history, the rational course in searching after causes is to examine the incentives of human action, the causes from which proceed habits of thought, theories of human rights, relations, and personal responsibilities.

In such inquiry there are certain postulates that can be set down as fundamental, and will form a guide for further and wider conclusions, among such postulates are these :

The liberty of the individual is opposed to the liberty of the commonwealth, the two things are inconsistent and impossible, except in a perfect community.

Civil laws are mainly to restrain the liberty or license of persons, and protect therefrom the liberty and rights of the people.

Public rights, such as protection from violence, theft, political corruption, knavery, and incompetence, are attained only by restraining the actions, and consequently the liberty of the "person," whose privileges must be thus abridged.

These propositions seem to be the same thing, and indeed are in nature, but are variously stated to make the fundamental idea of relative liberty more clear.

The cry of our time for "liberty" and enfranchisement of mankind is like an echo of the French Revolution, and has pervaded nearly the whole world, and has led to a tyranny over public rights that is growing, expanding on all sides, until it has permeated nearly all political systems of the world.

The person is supreme, shapes the legislative and even the executive functions of governments, controls the trade of most countries, brings about an unequal distribution of wealth by creating corporate combinations that have the characteristics and objects of the individual, but vastly more power.

No one with knowledge of the history and abuses of centralized government in the past will think of that as a remedy for present disorder. As mankind are now educated and trained, centralized government is out of the question. It would merely become a wider opportunity for the exercise of selfish action. There is no hope in that direction. Reform must come from below, not above. By below we mean from the people.

England, Belgium, Holland, Switzerland and the Scandinavian countries have best maintained the integrity of their political institutions, and if we seek for direct causes the most prominent will be the methods of taxation.

Inequality before the laws is the first step toward a disregard of law, and it is not too much to claim that all disregard for laws comes from a fancied or real inequality under it. Even the petty thief sets up the excuse that his crimes are warranted by the faults and discrimination of the laws.

In the countries above named the revenues are drawn mainly from wealth and property, and the people are not exposed to the temptations of a discriminating system. It seems strange to see among people professing the greatest love for liberty and equality a discriminating system of taxation. Out of such a system, as a government policy, is drawn the spirit of selfish inequality among the people manifested in trusts and other schemes to over-reach.

Even under the most centralized governments, like those of China, Russia and Turkey, this system of tax gathering by imposts on commerce has led to the same result as in republics, and while modern "corruption," the term commonly applied to public selfishness and bad faith, is not confined to any particular form of government, there is no doubt of its following with astonishing regularity unequal taxation, and there is no mistake of its influence in developing and sustaining unpatriotic sentiments, and perverting public opinion.

It is discouraging to think that all those now living in this country who were born sixty years ago can remember a comparatively pure system of public service and social relations among the people, with a corresponding immunity from the disorder and doubt that characterize the present time.

A person of that age will have lived during the administration of more than one half of the presidents of the United States, and will have seen two thirds at least of the development of the political, social and economic history of the country. If these people will look back over such a period of the past they will see a constant accretion of the power, privileges and influence of individuals, and a corresponding abridgement of, and disregard of, public rights.

The legislative branches of the Government, which once represented the Nation, now represent a horde of private or personal interests. Every Congressman is an "agent" of his district, with a principal object of securing appropriations, or other advantages, for his constituents, including, when possible, special laws. This is but an expansion of personal liberty or license, and an example of what is set down in the propositions at the beginning.

The measure of national liberty is never too full. It may curb and regulate personal action to any extent without wrong, so long as restraint is general and equal, and the time is coming for such restraint. The *initiative* and *referendum* in the Swiss cantons is a possible beginning of a method of reform coming from a most likely source. The preferential system of voting, and the Australian method of balloting, are also signs that point to some suppression of the "person" as opposed to the "people."

Of our systems of representatives and "government by committee" Mr. William Dean Howells says in a recent writing :

"Bad as their plutocracy is, it is still the best system known to competition conditions, except perhaps that of Switzerland where the initiative and the referendum enable the people to originate and to ultimate legislation, while the Americans can do neither. Here, the people, as you know, can only elect representatives, these again delegate their powers to committees, which in effect make the laws governing the Nation. The American plutocracy is the old oligarchic conception of government in a new phase, and while it is established and maintained by a community mostly christian, it is essentially pagan in its civic ideal."



TWELVE-INCH SIEGE MORTAR AND MOUNTING.

BUILDERS IRON FOUNDRY, PROVIDENCE, R. I.

TWELVE-INCH SIEGE MORTAR AND MOUNTING.

BUILDERS IRON FOUNDRY, PROVIDENCE, R. I.



The mortars like the one shown opposite, were described in No. 54 of this Journal. The object in the present case is to illustrate and explain the mounting, which is far more complex than the gun itself.

Eighty of these carriages or platforms are to be furnished, and with the mortars erected for the defence of coast stations and cities, some of them here at San Francisco, where foundations and other works are now prepared to receive the work.

The carriages are a combination of the English (Easton and Anderson) and Russian (Raskazoff) systems, on which there are American patents, controlled by the makers above named.

The following is a general description of the carriages, from a pamphlet issued by the Builders Iron Foundry :

"The 'lower carriage,' to follow the Government nomenclature, is made up of two cast-iron rings, placed one upon the other, and separated by a live roller ring of steel and wrought iron. The lower ring, termed the lower base ring, is permanently attached to the masonry by the holding-down bolts, while the upper ring, known as the upper base ring, revolves freely upon it by means of the intervening live roller ring.

The 'upper carriage' consists of a transom and two side frames containing the necessary mechanism for carrying the mortar, these parts being made entirely of gun-iron, and attached permanently to the upper ring of the lower carriage.

The mortar is mounted on two trunnion carriages which slide on the side frames. To each of these trunnion carriages is attached a piston rod, working in a hydraulic cylinder permanently attached to the side frame. At the same time the trunnion carriages are connected by means of the compression screw with the nest of springs contained in the spring cylinders, the upper sections of which are cast into and form part of the side frames.

These spring and hydraulic cylinders are inclined to the horizon at an angle of fifty degrees, and the mortar is arranged to fire only between angles of thirty-five and sixty-five degrees, so that the force of the recoil can be taken directly by these cylinders, and but little lateral strain communicated to the upper base ring. After the recoil the elastic force of the springs will usually return the mortar into battery. Should this fail, hand bars working in ratchets cut into the side frame, will accomplish the result. The training mechanism enables the upper carriage to be turned upon the lower, and the mortar pointed in any desired direction."

A CONDENSED ADDRESS.

This is a day of condensation and short cuts in all matters human, and we doubt if a better example can be found than the following. Mr. G. W. Dickie, of the Union Iron Works, was a short time ago asked to address a club at Belmont, near where he resides, on "California Industrially Considered," under a five minutes rule ! He proved equal to the occasion. We fortunately secured a report of his remarks, which were as follows :

"The other day I was asked to write an article descriptive of a modern line of battle ship that should be complete in detail, and yet not exceed two thousand words. As such a ship weighs ten thousand tons, every word had to dispose of five tons of complicated work.

Today I am asked to present to you an address on the industries of California in five minutes. I am afraid that I must tell you as I often have to tell a customer, that his job cannot be done in the time specified, without working over time.

Now, Mr. President, if you don't want to pay for over time, stop me promptly when the contract time expires.

At the present time the industries of California are being submitted to an endurance test which may result in some of them being crushed out of existence. This fate may seem cruel, hard, and unjust, to those who are thus deprived of the work for which they are fitted by nature and education. But this is the law of industry the world over, and California is no exception. Yet, notwithstanding the disappointing results that have followed the introduction of certain industries in this fair land of ours, there remain many fields of industry well adapted to the conditions of California life, on which as yet no cultivating hand has been laid. What magnificent possibilities are yet latent in the greatest of all our industries, where the reward of the honest worker comes from the bountiful bosom of Mother Earth, by the development of transportation facilities, the key to which lies in the construction of a water way for commerce through the attenuated waist of this continent. That key will open to hungry Europe the fruitful valleys of California. They shall yet eat of the fruit of our vineyards and orchards, kept fresh, in the dry cold air of a special fruit compartment on the quick freight dispatch steamers of the California and European line, via the canal. Our engineers will take the water of the mountains to the dry lands of the valleys, and this wonderful land will have more food to export as the consumers at home increase.

The more one learns of the natural resources of California, the less need he fear for the industrial outlook. We have everything

necessary for the building up of a great industrial commonwealth on the western edge of the United States.

But let us not forget that some of the most favored lands as to natural resources have cut no figure in the industries of the world. In the development of great industries men are of more importance than things.

Hitherto we have lacked in California that unity of aim and effort that is the chief characteristic of a homogeneous people. Our men controlling the various interests of the State are all more or less influenced by the peculiar methods of the countries whence they came, and the building up of the individual has been attended too often to the disadvantage of the State, and even of that particular industry in which the individual is engaged. This will in part disappear as a new generation rises up to lead the destinies of the State, and here will come in the part that such institutions as the one we visit today will play in our march of progress.

California's future is very much in the hands of the school-master of today. If our young men are well trained in habits of industry, if they come into the industries with a noble purpose, ready to give rather than to get, we need not fear for the future. We whose heads have whitened in the struggle to establish industries in this land of our adoption expect nobler service from the youth for the land of their birth.

The young man as he stands on the threshold of his active industrial life must be equipped to meet the competition of the world. The advantages of distance from the competing centers of industry that used to help us in California are fast disappearing, and he must enter the fight trusting in his industry and skill alone. He must gather all the experience from the past history of his own industry that his competitor has. He must know all that has been accomplished in the past history of the industry by which he expects to live, and what a vast heritage of experience is at the disposal of the coming generation.

The tide of human experience has become a mighty flood; we can trace its beginnings in the far off misty past, when man first began to learn that nature was but his instrument, and made his first infantile efforts to use it, fashioning weapons of bone or flint to protect himself against his enemies of the brute creation, down through the winding ages to this nineteenth century of light and progress, in which we find him wielding at will the phantom of steam and the lightning of electricity, conquering earth and sea by a power that nature had prepared for him, and laid up for his use in deep store houses, at the time when his naked foot first trod the soil he was destined to rule; and how this ever increasing experience is preserved and transmitted to us, and those who come after us in the imperishable symbols of language that have kept pace with the mighty tide of human progress."

EXTINCT RACES IN ARIZONA.

The Institute of American Archæology proposes a search into the ancient works found in Arizona, consisting of vast irrigating canals and other works, the remains of which point to a dense prehistoric population around Phoenix and elsewhere in this now almost desert country.

Mr. William O. O'Neil, writing in the *Irrigation Age* of February last says, in respect to the disappearance of these ancient people from the valley of the Colorado and Gila Rivers, and the Peninsula of Lower California :

"The mystery of their coming is no greater than that attending their going. Why after generations had lived and died, cities had been built, and the desert reclaimed, they should have disappeared, leaving not even tradition behind them, is one of those few mysteries of the human race still unanswered. The condition in which their canals were left, even to the smallest lateral, shows that so far as their irrigation system was concerned it was in a perfect condition, perhaps as perfect as it had ever been. Through it the land they inhabited had reached its utmost limit of productiveness, and that, too, to such a degree that millions could be supported by its products. The remains of their cities, too, indicate no gradual decay before their abandonment. On the contrary everything points to a land prosperous and populous, from which in a single day, apparently, its people have been swept as the winds of the desert sweep before it the drifting sand."

Corelated with these works are the "Ancient Monuments of the Mississippi Valley," as they are called by Squiers and Davis, in their celebrated work on this subject. We have examined a good many of these ancient works in Ohio, including the Great Serpent, the mounds at Circleville, Miami Town and North Bend, the latter on the estate of General Harrison, on an eminence immediately above or overlooking the home of J. Scott Harrison, the father of the late President of the United States. These works are, however, very different from those in Arizona, being either fortifications for defense or symbols of worship.

Whether ever this intricate chain of mystery is to be unravelled is doubtful. It is true that this far no great effort has been brought to bear, but without written symbols, and without philological clue, there has been no means to proceed, except by conjecture.

In the article before named, Mr. O'Neil says that while the whole of the works in the Eastern States do not cover five hundred acres,

those in Arizona cover "millions of acres." By "covering" is meant, as we understand it, the areas watered by these ancient canals. If so the comparison with works in the Mississippi Valley does not apply. These are different in nature and purpose, but bear such analogy as betokens their construction by a similar race of people. In speculations covering this and other obscure matters there is always a tendency to adopt the marvelous, and it is common to ascribe these works to some people and race that have disappeared.

A more reasonable conjecture is that these works were constructed by the Indian tribes found on the continent. A state of civilization that would account for all would be easily lost by interne-cine wars and other causes. Those that doubt this can see between the people in some parts of the United States and their progenitors, a decadence equal to that between the present Indian tribes and a people who could build the mounds and works in Arizona.

In an article published in this Journal last year, on the "Big Sandy" country, there is described a rough population that within two centuries runs back to the cavaliers of Virginia, educated up to the highest standard of their time. The Pueblo Indians of New Mexico, and the Digger tribes of California, show such a divergence in one race, and within distances permitting intercourse.

We are prone to regard the whole human family as progressing toward a higher civilization, but there is also retrogression. In Africa we know that there was once powerful organized nations that are now represented by barbarism, and even in this new country there are sections where, in forty years past, values, education and the general state of society has retrograded in a considerable degree.

HOUSE HEATING IN NORTHERN COUNTRIES.

In a book published here some years ago by Mr. George Wardman, called "A Trip to Alaska" is mention of a kind of heating stove employed at Kadiak, one of the large islands in the southern portion of that vast country. This stove turns out to be an old acquaintance. It is the "kalkelung" of the Scandinavian countries, also found in modified form in Northern Germany, and in various forms in Russia, from where it made its way to the Aleutian Islands in Alaska.

It is by far the most philosophical fire-heating device that is known, and may well furnish the subject of some remarks here in

California, where such appliances are unknown, but we will not say unnecessary, because they are precisely suited for heating purposes where a little heat distributed over a long time best meets the conditions of winter weather.

To begin with, and speaking of heating in general, it will be a strange proposition to say that as one goes northward in Europe the amount of fuel burned for heating purposes grows less. The most wasteful use being in the southern countries.

We once had occasion to have a room warmed at the Hotel des Etranges, in Paris, and managed, from six o'clock to eleven, to keep the *femme de chambre* busy carrying up brush in her apron. The trips could not be kept up at a sufficient rate, and the fire would burn out sometimes, and have to be rekindled, while the effect on the room could scarcely be noticed.

In Sweden an ordinary house, or *voning*, or "flat," as we say, of five or six rooms, can be warmed all winter with two *famn* ($3\frac{1}{2}$ cords) of wood, about what an English or American family would burn up in ten days, and without keeping warm at that.

The Swedish kalkelung (lime oven), which we take to be the most perfect form of these peculiar heating stoves, is built of masonry, from seven to ten feet high, and with lateral dimensions to suit the capacity required, commonly two to three feet square. They are built in the rooms and halls, constituting a part of the furniture of the building, and a tasteful portion at that.

They are commonly rectangular, from one and a half to three feet on the sides, but are sometimes cylindrical, especially the latter for halls or small rooms. The exterior is covered with encaustic or Dutch tiles, finely ornamented with figures or pictures in colors, and are in a high degree ornamental as well as useful.

The flues from the furnace to the point where the gases escape into the chimney are from forty to eighty feet in length. The flame and gases are led up and down in these flues, communicating alternately at the top and bottom, until all the heat is extracted and remains in the masonry. The furnace occupies a space of about two cubic feet at the bottom, and is filled with wood, set on end, "once a day," one fire in twenty-four hours, and quite enough.

Suppose that one is living in Sweden, and has a suite of rooms at a hotel, or elsewhere. About nine o'clock the *piga* (chambermaid) will come in with a bundle of wood, about as much as would fill an ordinary coal grate. She will first open a hinged pane in one of the windows of each room to admit fresh air, then open the brass

doors of the kalkelung and an inner pair of iron doors giving access through the thick walls to the furnace in the center. The wood is then set in on end, and arranged so as to make a roaring fire.

The flue is opened at the top by means of a slide damper, the fire lighted, and the *piga* then goes about her chamber duties. The fire roars and burns as though impelled by a fan, and hundreds of cubic feet of air is drawn in through the open panes in the windows to supply the foul air of the room drawn into the fire. In twenty minutes or so, the fire is burned out, the *piga* closes the inner and outer doors, the latter air tight, closes the damper in the flue of the kalkelung, the hinged panes in the windows, and goes out.

The tenant, if he be a stranger in that country, sits wondering what is coming next, wonders what the fire was for, goes to the stove to feel it, and finds no heat, and waits. In half an hour the stove is a "little warm," and in an hour it is quite warm, but not so hot as to burn one's hand, and there it remains at that temperature for hours, sinking a little toward evening, and cools down during the night when no heat is required.

Next morning these maneuvers are repeated. One fire a day, and the rooms filled with warm air, maintained at a nearly constant temperature through the day, commonly about seventy degrees. It is luxury, economy and common sense.

Contrast this with one of our red-hot stoves, fed all day long, the temperature of a room varying from twenty to thirty degrees as the fire is up or down; also contrast it with an English grate consuming from seventy-five to one hundred and fifty pounds of coal a day, a draught of cold air rushing in under doors, around windows, and the radiation through the single thickness of glass being just the same, except as to circulation, as though the windows were wide open. In the larger furnaces it is common to have mirrors set in the walls, and in the double kind, having two furnaces, niches in which are set vases of artificial flowers. In the dining room of the Hotel Rydeberg, at Stockholm, and in many public places besides, these stoves are a striking object in the rooms, imagined by strangers to be some kind of structure for ornament.

Coming down now to the practical features, the common objection to the system of house heating in Sweden is that there is not enough ventilation, and it is unhealthy. The answer is that the rooms are very high, sixteen feet or more, in all the better class of houses, so the contained air is not contaminated for a long time, and a farther and complete answer is that the Swedes are not

an unhealthy people, and by far too enlightened to tolerate anything of an unsanitary kind.

The plain truth is that they have excelled us in their methods, not only of house warming, but in a good many other things as well. They, for one thing, manage to get as much comfort out of an income of five hundred dollars a year as a thousand or fifteen hundred will buy here, also manage to school their children in a manner that is the wonder of the whole world.

HOW RAILWAYS ARE BUILT.

Now that the moral, economic and other features of the railway interest are being considered more than at any former time in this country, a view from the outside may not be amiss. The following, written by Dr. Van der Leyden, a Commissioner of Public Works, in Berlin, is an extract from a "Review of American Railway Securities." It may have the effect of preventing foreign investment in such securities, and that would not be an unmitigated evil for some years to come at least. The extract is from the U. S. Consular Reports.

"The initiatory steps necessary to form an American railroad company, are much the same as those taken to start any other stock company. No State or Government concession is required. It is sufficient for a number of persons to meet, form a company with the purpose of building a railroad, name the amount of capital stock, number of shares and their par value, how many shares subscribed, and have the whole proceedings recorded in a public register.

The Government does not care whether the road to be built will be useful, desirable, or necessary; whether the capital subscribed is sufficient; and finally, whether the payments on the subscribed stock are secured. Nor does the Government ascertain if payments on the capital stock (which often do not amount to over one per cent.) have ever been made. These cares are left entirely to the parties in interest to look after.

The consequence is that in the United States original stockholders got into the habit of making no payment whatever on their stock, or, when necessary, only such minimum payment as the law may have prescribed. It naturally follows that the shares of such companies are nearly or entirely worthless. Stock is generally divided among the incorporators; some of it is often given away to persons or corporations, who in the future may, through their influence and efforts, benefit the venture. It has also been a universal rule to interest, by giving them shares of stock, people belonging to law-making bodies, in order to secure their influence toward framing favorable legislation, or securing large land grants and concessions from the United States Government."

EXTRACTS FROM A NOTE-BOOK.

BY "TECHNO"

No. XXV.

LOW-PRESSURE STEAMBOAT ENGINES.—ALSO COMPOUND ENGINES.—AN
OLD WATER-WORKS ENGINE.—HOW CITIES ARE BUILT.—THE
FIRST OF STEAM-MOVED VALVES.—AN ASTONISHING
CARPET BAG.—CINCINNATI AS AN
ORIGINAL TOWN.

This was all extremely interesting to myself, as well as some others who were listening, but my main interest in the Ohio River was centered in its early navigation and steam boats, and the next lecture, to so call it, I deftly shifted to that subject, and have the following :

"My time of steam boating was long ago," said my Uncle. "Things are changed now, some for the better, most of them I suspect, but for wild, reckless, ingenious and dare-devil engineering the olden time never had or never will have a parallel.

"No one 'picked up' that trade. It required years and years with youth and vigor to help. Nothing from books those times, you had to see, learn, feel and do.

"I named vigor. There were no balanced valves down to 1850, and it required some weight and muscle to pull up a six inch poppet valve against one hundred and twenty-five to one hundred and fifty pounds of steam. Not every one could do it, and it was common to handle the throttle so as to avoid full pressure in the side pipes. By leaving the water cocks open and going a little slow, the exhaust valves were easier to raise, but it was no place for a weak man or a timid one. Theré were complications too. These western men were not dumb, or slow.

"There were condensing engines those times, the *Natchez* on the lower river about 1848, the *Northerner* and *Southerner* in 1850; cylinders six feet bore, and a hold full of condensing apparatus, that was all pulled out in due time and stowed ashore. It was too clumsy, heavy and difficult to handle, expensive to maintain, and when balanced up against the saving in coal, it footed up like the Indian's gun, 'cost more than it come to.'

"The *Northerner* and *Southerner* were built at Cincinnati I think, at least the engines were, and it was the pride of the people there to walk through the cylinders.' A man five feet eight could do it

with his hat off, and never forget it, but this is not all, we had compound engines those times, not slam ones or make-shifts but real tandem compounds, cylinders about sixteen and thirty inches bore.

"First was the *Hawkeye* with a heavy fly wheel and clutches for the wheels. One night the men made a miss with the clutches, threw both out at once, and the engine with about three revolutions threw the fly wheel, part of it through the cabin and the remainder down through the hull, the boat following in ten minutes, and drowning about two score of people. Next came the *Clippers* No. 1 and 2 with compound engines, and the *Memphis*. The last one I knew well and handled myself for a time.

"The compound engines were set amidships and took up a deal of room in a weak part of the vessel. The shaft too was a nuisance, terribly in the way, but they were compound engines just the same as the Elders introduced on the Clyde in 1870 and before.

"Cincinnati was a queer place those times, with more originality in an engineering way than could be found elsewhere on this continent. There is running there now a pair of water-work engines, poppet valve condensing, built about 1844, or fifty years ago, that persistently refuse to be beaten by others added since, down to the present time. There are half a dozen engines there, including a bull Cornish one eight feet bore, twelve feet stroke, all standing around these old steam-boat engines. They go on however, a monument to old-time skill.

"Lata got up the steam fire engines there about 1850, and direct acting steam pumps with steam-moved valves were invented about the same time, by a man named Wilson, in Cincinnati, much to the consternation of a great pump combination, formed about 1872, when this fact became known, as it did in a very sensational kind of way, which I may tell of some time. Just now I am speaking of steam boats.

"They kept on building them larger and faster, until a speed of sixteen miles an hour was reached; not over a measured mile and by triangulating shore marks as is done now-a-days. They had a better plan. For a time the packets between Pittsburgh and Cincinnati were the swiftest boats, and then came a competing line from Wheeling to Cincinnati as the western connection of the Baltimore and Ohio Railway. Two boats left Cincinnati every day, and there was a shore mark, a pole with a pair of buck horns on the top, that was set up at the end of a twenty-four hour's run. Any boat that could pass the mark in twenty-four hours moved the pole ahead to

her mark, and this was kept up until it got up to Parkersburg, Va. at the mouth of the Little Kanahwa River, or somewhere above there as I remember, and it would have been shoved up the river farther if steam boating had not fell into collapse by railway extension.

"Railways could not carry cheaper, but faster, and with the advantage of going all the time, besides could manage Congress and secure the passage of all kinds of laws to harass steam boats, until one hardly dares to show its head in these times.

"Under the plea of taking care of passengers, the pilots, engineers, captains and mates must be licensed periodically, the boilers and hulls must be examined, the equipment is prescribed and every kind of paternal care is exercised, but when the same passengers are to travel by rail, the Government turns them over to the mercies of the line, which may use dangerous machinery, ramshackle carriages, put incompetent people in charge and kill three thousand passengers a year without let or hindrance."

—At St. Louis we spent a day or two in looking around, and found the usual characteristics of all large American cities, evidence of its being built by "pressure from the outside," and to accommodate commerce.

In the old world cities were built first as the foundation, then their influence spread as from a generating center. The wealth, learning and skill flowed from the cities outward. In this manner the cities were tolerably well completed and put into comfortable order first, the country following. Here it is the opposite. A rich country around, presses on the cities which are built in half baked form, without the sanitary appliances, improvements or municipal order, that the Romans knew two thousand years ago.

Building a city is no small matter, it calls for the sum of all knowledge that exists and something more, but even this is less difficult than to govern one, or so it seems in these times.

St. Louis is fast taking on the attributes of a city, and aside from coal grime, bad odors and a tendency to crawl out all over the country, is quite even with her colleagues. The high price of ground, and the speculator in "additions," are the obstacles that beset a city set on a plain. Land values are evaded by "moving out," and the facilities for travel permit this, so the municipal resources when spread out over miles after miles of border area, are not enough to pave, sewer and light the streets. If one wants to build a good city, a wall should be built around it first thing, or it should be

put on an island or in a basin surrounded by hills, so it cannot "slop over," and flow out into the country.

This idea came first from my Uncle, but I have for some years past made it a measure of constant observations, and find the truth of it in all cases, and don't think we will ever have a model city, until the land on which it stands, belongs to the city itself. How far this system should extend I will not attempt to say, but every circumstance points to it being the only way of building and maintaining in an equitable and successful way, what we call cities.

————— I was impatient to hear the story of the Cincinnati pump inventor, and so reminded my Uncle of his promise one evening at the hotel.

"The circumstances" said he, "are typical of some others, that will or may find their way into that note-book of yours.

"This Wilson was a kind of a plodder, a cranky kind of fellow, who reasoned originally about things, and somehow stumbled upon the idea of amplifying the main steam valve of a pump into a piston, and then controlling its movements by a second valve moved by the main piston. The same idea was extended in what are called duplex pumps, indeed these are the same thing, only the main valves and their pistons not only distribute steam to another piston, but also operate a second pump.

"The matter lies here; no steam piston can move directly the valves that supply it steam, some other force must be called in, sometimes a spring, sometimes a weight that goes on and completes the valve movement, but best of all a little leading valve that distributes steam to a second steam piston which moves the main valve. I explain these matters to show what Wilson discovered or invented.

"Later on, about 1872, the various makers of direct acting steam pumps in this country, formed a combination, one of the first of the kind, to keep up prices. They put up a fund for litigation, retained the most famous patent lawyers, and set out to manage matters their own way.

"Out in Cincinnati there was a small firm, with small capital in money, but a tolerably large asset of skill and wit, who were making such pumps. The combination scarce regarded this firm, and intended to crush them with some sham law suits when the time came.

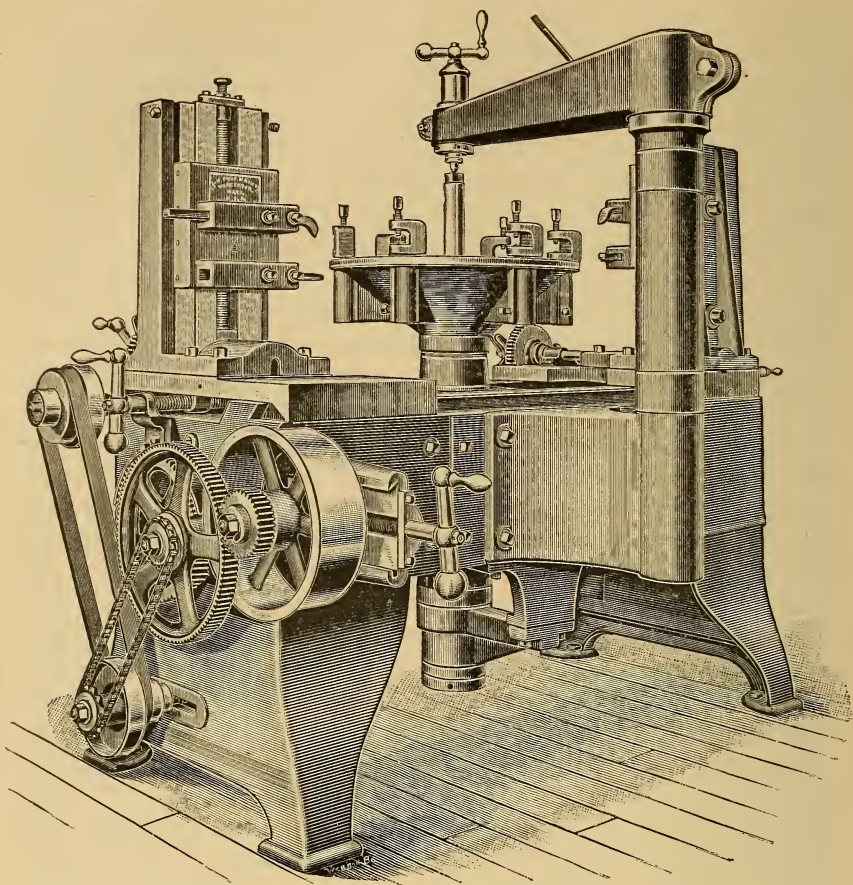
"There was a convention of the pump combination at New York, and the senior member of the Cincinnati firm, who was not

only then, but is yet one of the ablest hydraulic engineers in this country, packed up an old carpet bag full of papers, references, drawings and other ancient lumber relating to pump making in Cincinnati, and went to the convention. Of course he was not admitted, but on the last day, under an application for membership, which was assessed at several thousand dollars, he secured the right of being heard.

"He was a man of commanding appearance, given to laconic expressions, and the superior of any and all of the members in general education as well as on the subject of pumps. He quietly informed the convention that he was quite willing to pay the fee or assessment, as soon as he could see some equivalent that could be set up for his cash, but as the patents on which the combination was based were dubious, in fact invalid, he thought the sum of admission too high. This of course kicked up a commotion, and on being asked for his authority, the mild man from Cincinnati began to turn out the contents of his carpet bag on a table, and in a few minutes was admitted as a member free of all dues, and appointed one of the 'committee on patents.'

"I have left out a good deal, no doubt, remembering only the main circumstances, but it shows a wonderful phase of mechanic art in and about Cincinnati these times. Nor was this all, medical doctors there were famous, the wine industry began there; learning of one kind or another flourished. The North and South met there, but the city was hemmed in all around by hills, it got hot in June and never cooled off until October, the water was execrable, and mosquitos devoured one, but the city has flourished, and is one of the best governed in America. They once voted three millions of dollars in a lump to pave the streets, and at another time built a railway to New Orleans, the Cincinnati Southern, that has the bridge, twenty-two miles long, over Pontchartrain, which we will see later on."

(To be Continued.)

**IMPROVED METAL-TURNING MACHINE.**

THE L. W. POND MACHINE COMPANY, WORCESTER, MASS.

The machine shown in the drawing above, or rather the name of the company beneath, suggests two facts or circumstances that may be related here before noticing the machine itself.

Our last visit to the works of this company was in 1864, or thereabout, at which time, among other changes or extensions, a brick chimney seventy-five feet high had been moved across a block, then raised twelve feet, and a new base built under it, a feat we know no parallel for. How it was done we do not remember, but the fact was there.

The other circumstance, which has more relation to the implement shown above, was the fact of Messrs. Scoville & Son, of

Oakland, Cal., about ten years ago, making for their own use a turning machine very similar in arrangement to the present one, but of cheap and crude construction. This Oakland machine was always at work, and, no doubt, earned more money in proportion to the investment in it than any machine tool on this Coast. It was arranged to turn pulleys and other work from one to six feet in diameter, also for boring.

The machines made by the L. W. Pond Company are a refinement of the same scheme, and are in effect an inverted lathe with the advantage of a horizontal plate and chuck features of the American vertical boring machines, a type peculiar to this country down to a few years ago, but now spreading elsewhere.

The machines shown are made of several sizes, fitted up especially to turn pulleys with either flat or convex faces, tools being applied at opposite sides, as seen in the drawing, and are rapid and accurate in performance. The top support is swung out of the way when work is put on or removed, and is clamped rigidly when in working position.

It is not easy to define the differences between mounting work on vertical and horizontal spindles. The main point is of course the convenience of the piece lying at rest on a horizontal plate, but there seems in actual practice to be many more conveniences that are not easy to describe. The machine illustrated combines all of the advantages possible, and seems a thoroughly serviceable one.

SMOKE PREVENTION.

The literature of coal burning and smoke prevention is voluminous. We have treatise upon treatise, scientific, chemical, practical and otherwise, but the coal smoke and waste goes on nearly the same. Inventions of merit come and go, and no impression is made on the "stoker," who pursues the tenor of his way undisturbed. The art of firing, to so speak, is learned mainly in districts where neither coal waste nor smoke are much considered, and this brings us to two anecdotes in illustration.

An irate Philadelphian, who had the regulation white marble steps and trimmings for his house, white painted board shutters on the lower windows, once called on Mr. Charles B. Collier, a lawyer of that City, and asked him to bring an action against a smith who used bituminous coal in the vicinity of the complainant's house, and

"ruined things," as he said. Mr. Collier was originally a Steubenville man, born and raised there, and held a different view of smoke. "Why," said he, "if that man lived in Steubenville he would be indicted for not making enough smoke. Smoke is wholesome, I like the smell and appearance of it, better let the smith alone, or advise him to move alongside my house."

Anecdote number two relates to an inventor of a very useful grate bar here in San Francisco. These bars he claimed saved coal and prevented smoke. He concluded to "go East," where more fuel was burned, and introduce his improvement, but when in the coal districts found that coal saving was an "iridescent dream." No one wanted to save lump coal at \$1.25, and culm at nothing per ton.

The fact is that men cannot be induced to fire in a way that will avoid smoke if that entails more labor and care without raising wages, and the ways of firing are fixed where coal is \$1.25 per ton, or less. We once saw twenty tons of slack coal put on a Monongahela steamboat at a cost of seventy-five cents for the whole, and that amount was paid for handling.

Methods of preventing smoke are tolerably well understood, and are also tolerably uniform, the difficulty, as Captain Cuttle would say, "lies in the application."

CALIFORNIA GRAY SQUIRRELS.

The California gray squirrels, (*sciurus fessor*) for a "dress name," are curious little animals, with various distinctions from their brethren of the Atlantic States. They are larger, more graceful, and less timid, but, as an Irishman once remarked to the writer, "are the divil for bitin'." An Eastern squirrel when thoroughly tame rarely "nips one," but these California rodents are not to be trusted.

The tails are different, nearly twice the size where they join the body or spine, are also longer and wider in proportion to the body. There is a tuft of reddish hair behind the ears, not found in any other except the fox squirrel of the Southern States, but the main points of difference are of habits and disposition.

We have bred them in cages, and studied a dozen or more, some of them captured wild when full grown, others raised from "kittens" on condensed milk, not cow's milk, which will soon kill a young squirrel, for some reason not understood.

The mother in confinement, and eating unnatural food, cannot nourish the young unless bountifully fed, and not then except for

the first month or so. Like all animals of great muscular strength and long life, squirrels are of slow growth, not reaching maturity in all respects for two seasons.

It is a common belief that squirrels will not breed in cages, which is correct if a male and female are confined together. They are not pairing animals, as any one knows who has studied their forest habits. The female with young will fight to death with a male squirrel that approaches her nest.

Before the young ones come out of the nest, which will be at six weeks or more of age, the nest must not be touched. The sense of smell is so acute that if the young are merely touched with one's finger when the mother is absent, she will instantly on her return set out to "move," carrying the young one at a time to some new place of fancied security. She seizes them with her teeth just in front of where the hind leg joins the body, and the little kitten then coils itself around her neck like a collar, so deftly as to be scarcely noticed. She will then deposit her charge in some new place, where it will lie as still as if dead until the mother returns with further orders. The only way to pacify a mother when her young have been disturbed is to prepare a new nest, let her make it over, and return her brood when no one is watching.

When the young squirrels come out of the nest they can be fed, but must be taught to drink without immersing their nostrils. This can be done with a spoon, or a thin dish, and one or two lessons suffice. As in the case of the mother, condensed milk only should be used, thinned with water, and warmed at first.

When half grown the antics and play of the "kittens" is highly amusing. They are never still, and always graceful in their nimble performances. The most valuable and amusing squirrels are the chattering females, one out of six perhaps, that keeps up a continual scolding, squealing, or talking, as one may say. The habit develops at a year old, and becomes more marked with age. Out of a dozen or more we have had but two of the "scolding" type.

Green food of some kind is essential, and it is cruel to not furnish it. Fruit of any kind, cabbage, carrots or rose leaves will do, but a certain amount of such food is necessary. Spent lime also seems to take the place of salt with other animals, a whitewashed stick is a luxury. Nuts and grains are, of course, the natural food, which should be varied, and in all cases squirrels should have access to earth. No animals form more cleanly and amusing pets than California gray squirrels.

MILDURA, AUSTRALIA.

About 400 miles inland, on the Murray River, in Victoria, Australia, is Mildura, an irrigation colony founded by a contract between the Victorian Government and Chaffee Bros., a Canadian firm of engineers, who carried out similar works here in California.

We have several times before spoken of the terms of the contract, which are peculiar, but seem to have been carried out in good faith and with success. The land set apart for irrigation and for the colony was 250,000 acres, nearly all of which can be watered from various elevations, the extreme height being 80 feet.

The water is all pumped from the Murray River at three stations, between which the lift is divided. The pumps are all of the centrifugal type, and give a good efficiency with a minimum cost for maintenance. At the first station, which supplies a considerable area of the land, there are four pumps of 40 inches bore that raise 120,000 gallons per minute. The head here is variable owing to fluctuations in the level of the river, which reaches 20 feet. The engines, made by Messrs. Tangye Bros., of Birmingham, England, are of 1,000 horse power. The other two pumping stations are smaller, the last one reaching 75 to 80 feet above the river.

The products correspond to those of irrigated lands in Southern California, and give promise of very profitable cultivation. Of course something must be learned tentatively as to different crops, but the experiment has now gone far enough to be called a success, not only in a financial way but a much greater success in a moral way. There is harmony among the 4,000 people who have made their homes there, and none of the disorderly features common to new places founded beyond the fringe of "civilization," as we call it. The main thing is, however, in the commercial conduct of affairs, thus described by a correspondent writing from there :

"The establishment of the Mildura Fruitgrowers' Association is evidence of practical progress. It is a limited company on the coöperative principle. No profits are to be made, the charges to the members being on a scale merely covering the cost of handling and conveying to market. This season the Association will pack 150 tons of raisins. All the machinery used by the Association was made in Mildura.

Another agency for preparing and marketing the fruit produce of Mildura is the Planters' Union, a limited company of \$100,000 capital in \$5 shares. W. T. Allen, a California fruit expert, is chairman of the company."

FIRES IN FACTORIES.

Mr. Edward Atkinson, in the *Engineering Magazine*, claims that the property burned in the United States last year was worth \$150,000,000, and that to estimate the "fire tax" on this amount 60 to 70 millions more must be added as the cost of sustaining insurance companies, also the cost of maintaining fire departments in cities, so the whole cost of fires for the year was about 250 millions of dollars.

Of the causes he says: "This is the penalty we pay for ignorance, stupidity, carelessness and crime, for which the responsibility must be distributed mainly among owners of buildings, though shared in part by occupants, architects and builders."

In respect to the prevention of fires, or the salvage of buildings, Mr. Atkinson says:

"For instance, wherever the mill floor, suitably constructed of three-inch planks, grooved and splined, covered with one-inch top boarding, laid on timbers eight or ten feet on centers, has been made continuous—that is to say, without any break for belt holes, open elevators, or open stairways—it has never been burned through by fire on the floor, or by fire passing through the floor above, except in one instance, and that was a warehouse where a pile of jute bales took fire in a place where it could not be reached. The firemen then put water through the hole from open butts, and drowned it out. Fires on such mill floors have been held, not only in the building, but in the room where they originated.

Again, the iron posts have been crippled or sprung by heat a great many times at an early period in a fire. A wooden post of suitable size has never burned off until other parts of the building were already destroyed. They have in one instance resisted for hours fire which destroyed granite posts near them by reducing them to sand, the granite measuring 12 × 12 inches. In this instance oak posts were put in between the original posts of granite to bear an added weight of machinery. When the fire came the oak sustained the whole load.

To repeat, the mill floor properly constructed, and rightly guarded, has sufficed to hold fires not only in the building but in the room in which they have originated, until the mill fire department or the public fire department could extinguish the fire. The wooden mill post of suitable size will last longer than the floor. The mill floor possesses this very great advantage over the ordinary joisted floor, fires may be readily swept away between the timbers either by sprinklers or by water from hose pipes, while in the joisted floor, or floor laid over plank on edge, 18 to 24 inches between

centers, the fire will burn on one side of the joist or plank while the water is playing on the other side."

This will explain the "plank floors" in Eastern factories that people often wonder at. Such floors are far from firm for machinery, but are, no doubt, expedient for the reasons above given.

EFFICIENCY OF INJECTORS.

The following from the *Mechanical World*, and taken as we believe from the writings of Mr. Kneass, of Philadelphia, is a very clear explanation of injectors.

"The actual cause of the inefficiency of the injector from a mechanical point of view is due to its dependence upon the principle of impact for the transfer of the actual energy of the steam to the moving water; this induces such an enormous waste of power that its use as a pump for raising water is out of the question except in such cases where economy of steam is no object, or where the heating of the delivered water may be advantageous. The momentum of a body is equal to the product of the mass by the velocity, and the resultant velocity after impact is equal to the sum of the momenta of the two bodies divided by the sum of their masses; on the other hand, the actual energy is proportional to the square of the velocities. Even if there were no loss of momentum in the injector, yet there would be a dissipation of energy, owing to the reduction of velocity. If one pound of steam moving at a rate of 3,000 feet per second, strikes nine pounds of water at rest, and imparts all its momentum, the resultant velocity of the mixture would be 300 feet per second, yet the energy of the jet of water and steam would only be $\frac{1}{10}$ of that of the initial steam; for

$$\frac{\text{Final energy of jet}}{\text{Energy of steam}} = \frac{(300)^2 (9 + 1)}{(3000)^2 \times 1} = \frac{1}{10}$$

so that the greater the difference between the velocity of the steam and the final velocity of the delivery, the greater the loss of actual energy; but other considerations, as before described, show the advantage of a low terminal velocity in the injector, and that the real efficiency as a boiler feeder must be measured in other ways.

As an example, the efficiency of the jet will be calculated in the case of the experiment (a), Table IV. The velocity of the steam is 3,435 feet; of the entering water, 40 feet; and of the jet, 165.3 feet; the weight of water delivered per pound of steam, 12 pounds; therefore —

$$\left\{ \frac{(3435)^2}{2g} + \frac{(40)^2 \times 12}{2g} \right\} K_1 = \frac{(165.3)^2}{2g} \times 13$$

$$K_1 = 3 \text{ per cent.}$$

and from this value there is not much variation throughout the ordinary range of steam pressures."

CARRYING COALS TO NEWCASTLE.

Mr. W. G. Curtis, in a paper read before the Technical Society of the Pacific Coast, on the third of last month, ended his remarks with some statistics that will be a matter of astonishment to most people. We quote as follows :

"The California small farm owners are not quite living up to their opportunities for supplying our local markets. That there is room for a profitable development in this direction is evidenced by the fact that last year there was brought, by rail lines, from the East into the Pacific Coast States, practically all of it coming into California, 39,945,000 pounds, or about 2,000 ten-ton carloads, of stock-farm and poultry-yard products, in their natural state or manufactured into staple commodities ; over 36,000,000 pounds of this tonnage was composed of articles of food, such as butter, cheese, poultry, meats in bulk, lard, eggs, condensed milk, etc.; the shipment of eggs alone amounting to 5,500,000 pounds. In addition to this, in 1893, there was shipped from the Eastern States and foreign countries into California, by rail over 13,000,000 pounds, and by sea about 70,000 packages of canned goods, including fish, oysters, canned meats, canned corn, and other vegetables. Undoubtedly articles corresponding at least to one half these goods, are now, or could be, produced in California.

Of other articles annually shipped to the Pacific Coast from Eastern States, or imported from foreign countries, which might be supplied by California farmers, may be noted over 9,000,000 pounds, shipped by rail, and about 900 packages by sea, of alcohol and spirits ; over 1,250,000 pounds by rail, and about 1,500 packages by sea, of dried fruit and dried currants ; nearly 1,250,000 pounds of oats ; over 1,000,000 pounds of pickles, preserves, and jellies ; over 3,700,000 pounds of cornmeal and oatmeal ; nearly 1,250,000 pounds of farm and garden seeds ; nearly 2,000,000 pounds by rail, and over 11,000 packages by sea, of wines ; nearly 1,500,000 pounds of broom corn and brooms ; over 60,000 pounds, by rail, and about 14,000 packages, by sea, of olive and salad oil, not to mention 'coals to Newcastle' in the shape of 9,000,000 pounds, by rail, and 1,000 packages, by sea, of flour.

In the way of other things that California can likely produce for the supply of local wants and general markets of the world, are textile grasses, flax, hemp, jute, and fibrous vegetable substances other than cotton. The value of these raw materials and articles manufactured therefrom, imported into the United States for the year ending June 30, 1893, was in round numbers, \$49,500,000."

We regret that this paper was received too late to be republished, and we can select only this most salient part, pointing to a proverbial want of what may be called administrative skill in vari-

ous industrial interests on this Coast, not due so much to natural capacity as the want of near precedents and the schemes that thwart and "cinch" the farmers. The main thing is, however, "administration." We have, in the last fortnight, visited several poultry farms, and the want of organization, order, cleanliness and attention would in a commercial or manufacturing business ruin it in a season. This importation of food, such as the country is eminently fitted to produce, should be more widely known.

PNEUMATIC POWER TRANSMISSION IN PARIS.

There appeared recently in the *Colliery Guardian* an account of pneumatic power in Paris, that is a good example of concise description, and present interest in this subject warrants a reproduction of the matter here, as follows:

* * * * *

"The works of the Paris Compressed Air Company date from the year 1870, originating in an installation for working pneumatic clocks; in 1889 there were about 8,000 pneumatic clocks, public and private, all of which are driven from the small installation referred to, being regulated by a standard clock. In 1887 the new installation, on a large scale, was put down in the Belleville district of Paris, owing to the increasing demand for power to work motors larger than those hitherto used. The steam engines were six in number, horizontal, compound and condensing, with the requisite number of boilers, each engine driving two air compressors. The engines were made by Messrs. Davey, Paxman and Co., of Colchester, and the compressors were of the Blanchod type made in Switzerland. The demand for power still increasing—at this time over 2,000 indicated horse power being given out by the engines in the busiest parts of the day—in 1889 a further extension of the plant was made; half of the new engines and compressors were constructed by the above firm, and the other half by the Cockerill Company of Seraing, Belgium, and new mains in duplicate were laid throughout.

The air is compressed to five atmospheres = $73\frac{1}{2}$ pounds effective, or six atmospheres absolute, being drawn through the suction valves at 70 degrees Fahrenheit. Water for cooling is passed into the compressors with this air, whereby its final temperature on leaving the compressor is about 150 degrees Fahrenheit, after it has passed short distances along the mains it falls to the original temperature, somewhat near 70 degrees. If the air were treated in the compressor adiabatically, that is without any cooling medium, its temperature on leaving the compressors is calculated to be 430° Fahrenheit. It may be observed that the cooling in the compres-

sors was not at first effected successfully, as shown by the final temperature of 150 degrees; more complete mechanism now furnishes fully compressed air almost at the same temperature as when entering the compressors, a very small loss from heat is thus occasioned. The water injected for cooling gives a certain advantage, as it practically fills up the clearance spaces at each end of the cylinders.

The compressors are double-acting, two compressors furnishing $47\frac{1}{2}$ cubic feet in one revolution, the quantity of water used being about $\frac{1}{4}$ gallon. After compression, the air—now having a pressure of six atmospheres absolute, and a temperature of, say, 100 degrees Fahrenheit or less—is forced into receivers of wrought iron. Some of the receivers are arranged to separate the water from the air before entering the mains; there are also traps in the pipes at intervals to carry off the water deposited in them. The two principal mains are of cast iron, 11.8 inches diameter, $\frac{3}{8}$ inches thick, which are laid partly under roadways, while others are suspended from the top of the sewers.

Professor Kennedy, M. Inst. C. E., experimented on the compressed-air plant at Paris in 1889; some of the notes following are extracts from his report. Most of the air produced from the new compressors actuates motors for small industrial works and for electric lighting: over 225 motors were thus worked, varying from $\frac{1}{8}$ horse power to 50 horse power, most of them distant two to three miles from the central station. In several instances the motors drive dynamos for electric lighting; others are used in newspaper offices, both large and small, to work the printing machines. Also for driving lathes for metal and wood works, circular saws, drilling, shearing, polishing, sewing and other machines; also in carpenters', smiths' and cabinet makers' workshops, also for coffee-roasting, confectionery and other trades.

Before being used at each motor the air is first passed through a meter, which has a fan inside that indicates by the number of its revolutions the quantity passing, approximately, serving as a basis on which payment is made. The air is afterward passed through a reducing valve, which limits the pressure to the requirements of the motor; in practice the pressure varies from $3\frac{1}{2}$ to $5\frac{1}{2}$ atmospheres absolute, in accordance with the work to be performed by each.

In most cases the air is heated in a coke stove before passing on to the motor; but where power and refrigeration are both required, the heating is either dispensed with wholly or only sparingly used.

The motors, taken altogether, are of two types, the first being the small patent rotary engines, ranging up to 1 horse power, used for the pneumatic clocks. Of the second type, the largest sizes have two air cylinders, 12 inches diameter by 14 inches; these are similar to an ordinary steam engine, fitted in most cases with automatic cut-off gear and controlled by governors.

The experiments were instituted to show the relative indicated horse-power expended by the main steam engines, the indicated

horse-power given out by a motor, distant about three miles from the former, giving the several resistances in the transmission, and the total efficiency from the work done.

The losses referred to are as follows:—(1) Friction and leakage in the steam cylinders; (2) friction and leakage in the air-compressors; (3) resistance and leakage in the mains; (4) resistance at the reducing valve; (5) friction and leakage in the motor itself.

When a heater is used at the motor a further loss is occasioned from the value of the coke used; this, however, will be somewhat modified by an increase of pressure due the heating, and by the prevention of freezing at the exhaust. It has been truly said that the occurrence of ice at the exhaust ports depends more on the quantity of moisture in the air than on a very low temperature. In one case the air was heated to 315 degrees Fahrenheit before entering the motor; when cold the air on entering the motor was 69 degrees to 71 degrees Fahrenheit; the heating gives an increase in volume of air of about 42 per cent., but this apparent advantage is outweighed by the cost of heating.

The experiments show that the indicated horse power of one pair of the main steam engines at the central station was at $31\frac{1}{2}$ revolutions per minute, equal to 254.9; at all speeds it was approximately 8.1 horse power for each revolution, the power being taken at speeds of 21 to 44 revolutions per minute. The mechanical efficiency of the engines was the same at all speeds—viz., 84.5 per cent. The system of transmission which gives an indicated useful effect of about 50 per cent. commends itself to notice, especially when its safety and convenience are so great, and its possible applications are so varied. Thus, 20 horse power at the main engines produces 10 horse power at a small motor four miles distant from the former, allowance being made for the value of coke for heating the air at the motor.

By using air direct from the mains in the motor, the exhaust can be so reduced in temperature as to be available for freezing purposes. For instance, in one Paris restaurant the primary function of the motor is the lighting of it by electricity; an auxiliary benefit is derived from making large blocks of ice at the exhaust of the motor in the cellar where it is placed, the ice being used in the restaurant.

This plant furnishes an excellent guide to the economical working of air-compressors in coal mines, the methods of getting the efficiency of the steam engines and the motors underground, and of taking the temperature at the various points indicated, being all of practical importance."

OIL BURNERS.

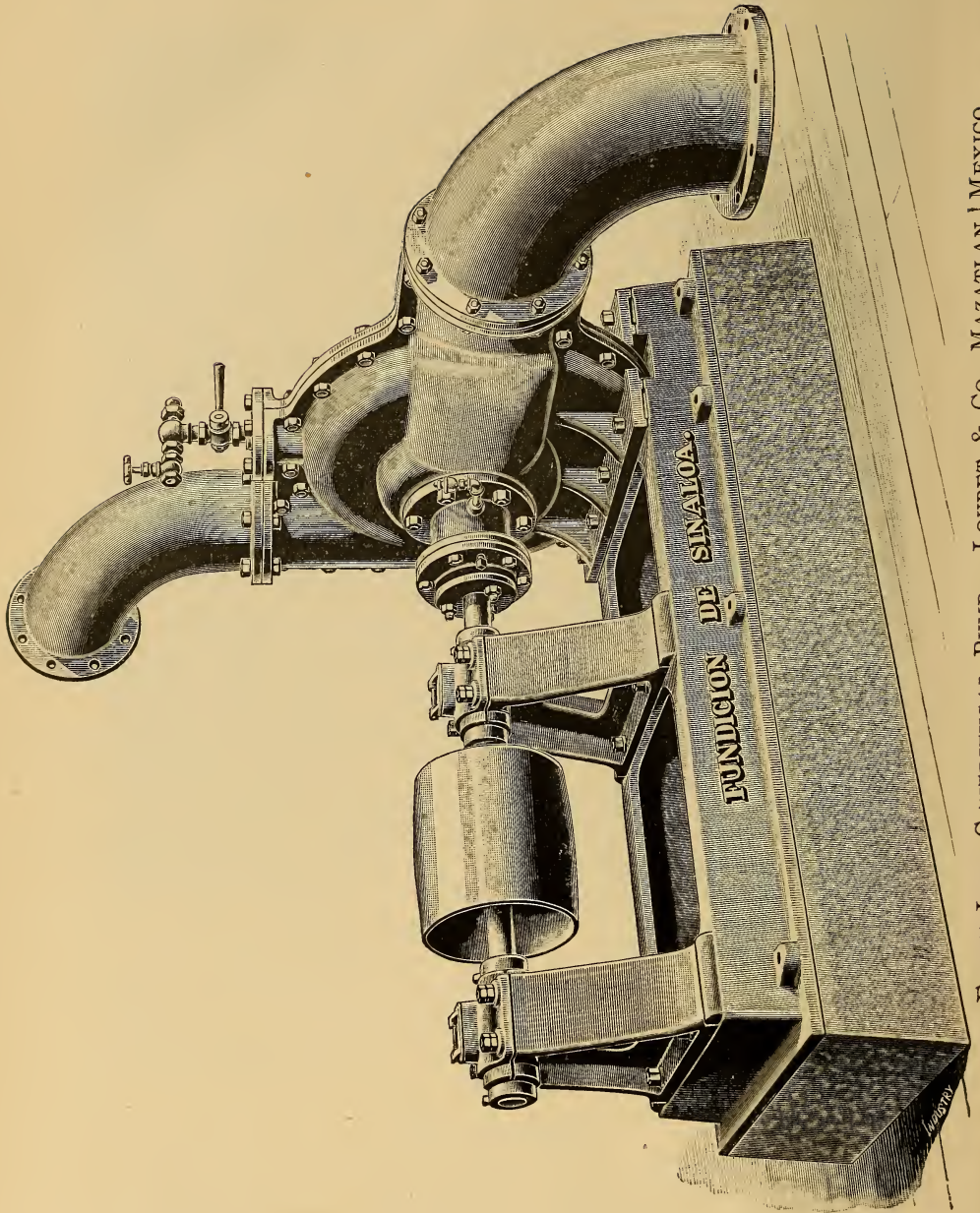
Last month we published some remarks on oil burners, that have called out a number of inquiries in respect to the form used in Russia. This we cannot answer, but will quote part of a letter

written by a Russian "boiler owner," at Moscow, to the editor of the *Mechanical World*:

* * * "In visiting the World's Fair, one of the first things to occupy my attention was to find a good naphtha burner, thinking it would be a good thing to take with me to 'backward Russia;' but to my disgust, in visiting the boilers, I found I had travelled thousands of miles to see that the American systems were copies of long-ago discarded Russian systems.

In referring, first, to the supposed best American burner, I will take those exhibited by the National Supply Company. These burners are a direct imitation of the Spakoffsky, worked in Russia as early as 1870, on the Caspian Sea. They are large, clumsy burners made in several sizes to suit requirements, and are generally called here 'boiler destroyers.' They pulverize the fuel at the expense of a great amount of steam, and give a flame so severe that the boilers have to be shielded by brick arches, otherwise they would soon give out. These protections not only absorb a deal of heat, and rob the boilers of heating surface, but they only last from six to ten days, when they must be replaced—a serious matter in expense and stoppages, more than covering all the would-be economy obtained by using oil fuel.

The burners we have in Russia are far more advanced, and the Bray takes the pride out of the Americans in every respect. It requires no firebrick protections to shield the boilers from injury, and the flame is not severe. It is very simple in construction and management, besides which it is only made in one size, which is about one-quarter of the size of those exhibited at the Fair, although it will do more work than those of America. I have seen Babcock and Wilcox boilers fired with the Bray burner without any preparation whatever, giving a flame that rolled completely through the boilers. They were merely fixed in the firedoor with the firebars bare, so that they might be turned out from the firedoor once a week to burn chips and shavings when so needed. Although these boilers had been working over four years under these conditions, there was no sign of injury of any kind." * * * * *



EIGHT-INCH CENTRIFUGAL PUMP.— LOUBET & Co., MAZATLAN, MEXICO.

BEAM-ENGINE HAND GEAR.

The arrangement of the motion levers of beam engines by mounting them all on the cam shaft, originating, as we believe, in the old Fletcher and Harrison Works, in New York, has been imitated on this Coast, naturally, no doubt, but mistakenly in respect to the lever to handle the cam hooks.

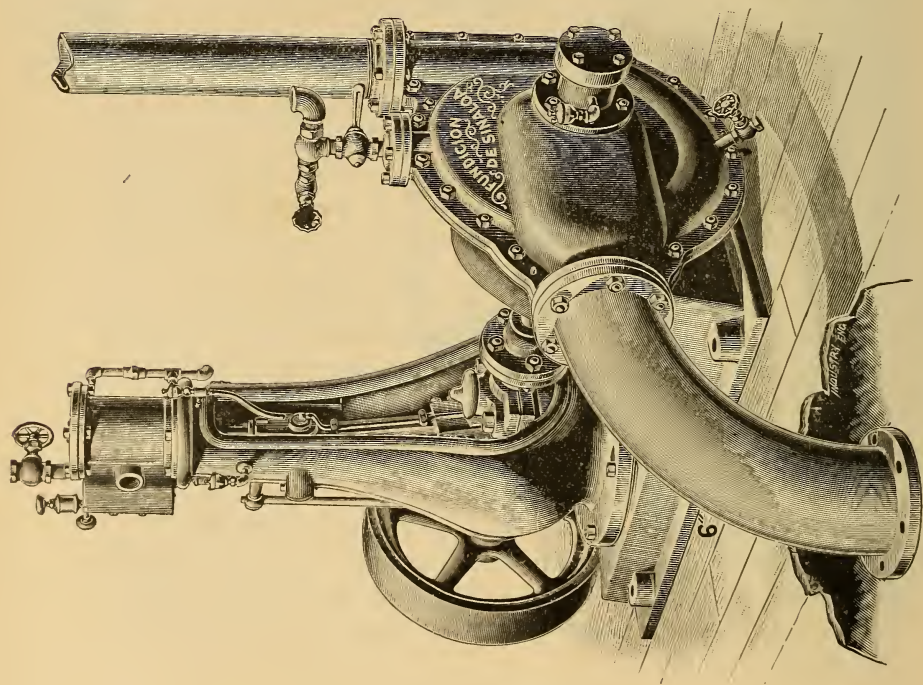
These little levers, sometimes not more than twenty inches long, may do very well to operate a balanced throttle valve, the injection and feed, but the cam hooks require something more. Double hooks require three points for latching, and this, in the New York arrangement, is provided for by a detent pin passing transversely through the lever into holes in a small disc, the radius to the pin being not more than four inches from the center.

A similar function for hand levers is, on this Coast, commonly provided for by a lever four to six feet long, a quadrant of one to two feet radius, and a strong pawl or detent operated by a handle that can be grasped at the same time with the one on the lever. If the makers of beam engines here were to vary this detail so as to conform to their practice in other things, there would, no doubt, be a protest from inspectors, but this does not prevent the fact of small levers being weak and dangerous practice.

One of these contrivances last month caused the *Sausalito* to jam her landing, causing a large amount of damage, and we think the builders of the vessel would have done well to disregard this Eastern contrivance, and substitute a hook-on lever to correspond with their usual practice, about ten times the size, held by a sector set on the deck, having heavy notches six to ten degrees apart.

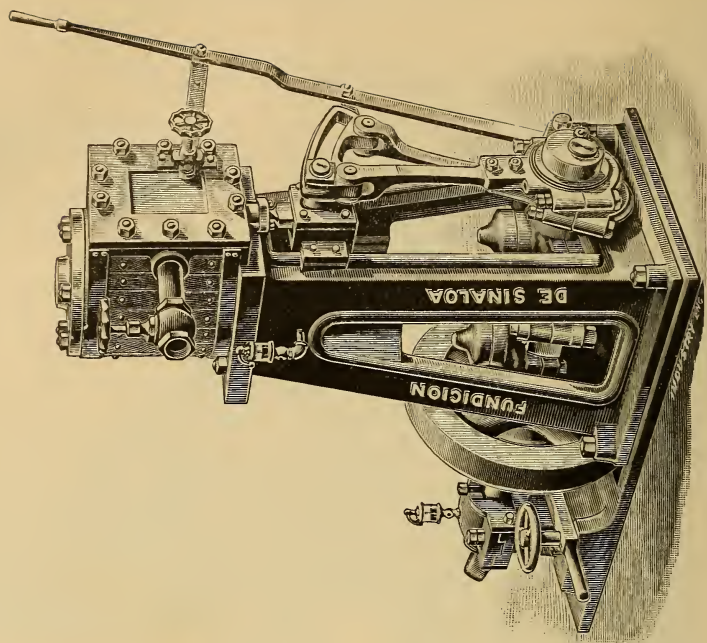
It may not look so neat, but as an engineer must have one hand on the starting bar, and has but one for the hook lever, that should be convenient, of long range, and strong beyond any possibility of derangement or fracture.

As before remarked, other operations not requiring so much force, and the failure of which would not lead to such serious consequences, can be performed by short levers on the cam shaft. The position is convenient unless detents are required, and no fault can be found with an arrangement that is general among the makers of beam engines, but a reversing or cam-hook lever is quite different and requires something such as can be seen on a locomotive or a link hoisting engine.



TEN-INCH CENTRIFUGAL PUMP.

LOUBET & CO., MAZATLAN, MEXICO.



REVERSING STEAM ENGINE.

LARGE GAS ENGINES.

Mr. J. H. Killey, of Hamilton, Canada, writes of gas engines in the *Canadian Engineer*, commencing as follows :

"Rivalry with steam power in an economical sense is now the order of the day among advanced mechanicians; perfectly successful gas engines up to 600 horse power are now in operation, running with the steadiness and the regularity of the steam engine, not taking more than 1 pound of inferior coal per horse power per hour, while some builders claim that they can build them to run with $\frac{3}{4}$ pound. A gas works in the States has a 300 horse power gas engine running a dynamo, enabling them to supply electric lights in addition to gas light at a net cost far below that of the most economical steam engines and boilers.

An European engineering firm have contracted to build a gas engine of 1,000 horse power, which it is expected will run with $\frac{1}{2}$ pound of coal per horse power per hour. Tangyes, of Birmingham, England, advertises gas engines of 40 horse power, which are guaranteed to work with less than 1 pound of coal per horse power per hour—a remarkable result for so small an amount of power.

If gas engines can be successfully constructed and set to work of 1,000 horse power, why not of 2,000 or 3,000 horse power, if wanted? Dowson gas can be manufactured for 20 to 25 cents per 1,000 cubic feet. This gas is largely used in gas engines of large power; this is about one half the cost of the fuel for the most economical steam engines."

This view of the matter may be too sanguine, but the time is within view when a part and perhaps a large part of the present steam engine making capacity will be changed to gas-engines. The contract above alluded to for a 1,000 horse power engine, is no doubt with Messrs. Dunlop & Co., who have for some time past made a speciality of gas engines of large power.

EXAMPLES OF MEXICAN MACHINERY.

LOUBET & CO., MAZATLAN, MEXICO.

On pages 678 and 680, preceding, are perspective views of two centrifugal pumps and a reversing steam engine, made by Messrs. Loubet & Co., Mazatlan. The designs are a compound of European and American practice, and show substantial proportions, with good arrangement throughout. The engravings were made from photographs sent by the firm without description of the machinery, which is however unnecessary, as everything is indicated in the drawings. Some other examples of the firm's work will be given in a future issue of INDUSTRY.

LITERATURE.

Graphics of the Efficiencies of the Steam Engine.

BY PROF. R. H. THURSTON.

Professor Thurston is a man of tireless activity. One no sooner follows through one of his investigations than another appears, and each time the margin of useful data is advanced, or previous propositions qualified. His latest paper, read before the Franklin Institute, Philadelphia, in August, on thermo-dynamics, is entitled "The Graphics of the Efficiencies of the Steam Engine," which is so far as we know the most considerable effort yet made toward a mathematical solution of what may be called "dynamic economy."

In a series of diagrams made to comprehend the conditions under which steam engines of various kinds operate, the determination is in pounds of steam, and as he remarks, might just as well be in dollars and cents, a fact that is commonly overlooked, and cannot be too strongly presented, because the final object, disguise it as we will, of physical research comes back to the practical object of gain. On page 5 is given the following, showing the wasted power or heat in a high-speed engine.

Energy stored in steam produced in the boiler and transferred to the engine, rated at 100.

EXPENDED.	Per cent.
Utilized by conversion into dynamic energy at the engine.....	9
Wasted by friction.....	1
Indicated horse power.....	10
External thermal waste.....	2
Thermo-dynamic wastes.....	60
Internal thermal waste.....	28
Total.....	100

The proportionals of these quantities, plotted in conjunction, for single, compound, triple, and quadruple engines, indicate the steam consumption or cost of fuel in each case. The author suggests as elements in such diagrams, the external wastes or cost, such as interest, rent of room, maintenance, and so on, giving hope of sometime in the future finding purely economic problems solved thus mathematically.

Technology Quarterly, April, 1894.

In this number of the *Quarterly* a prominent place is given to a very interesting essay on "The Wooden Architecture of Switzerland," three fine illustrations being given to show types of construction. Some of the examples are more than 350 years old, and the wonder is how wooden structures can last that long in a climate that has long periods of moisture and great variations of temperature. The writer, Mr. William Danmar, attributes the durability of these old wooden houses to their perfect construction at the beginning and to over-hanging roofs that act like an umbrella to protect the walls.

The style is remarkable in respect to ornamentation, and the projecting gables and eaves, which seem to be as much as one fourth of the width of the houses, supported by immense brackets. There is little to learn or imitate in such things. No one at this day wants a house to last two or three centuries, or is willing to spend money for over-hanging roofs wide enough to protect a building from the weather.

Another article of interest relates to the wool-growing industry of New South Wales, where there are estimated to be 60,000,000 sheep, an inconceivable quantity.

Prof. J. H. Stanwood supplies formulæ for the permissible load on posts of white pine, which seems a simple matter, but it is not, because a neglect of ascertaining proper loads for such posts has cost a good deal in the Eastern States. The formulæ are:

For yellow pine or oak, $S = 1,000 - 10 \frac{l}{d}$

For white pine or spruce, $S = 800 - 10 \frac{l}{d}$

S being stress in pounds per inch of section, l length of piece in inches, and d diameter of the piece in inches, with a factor of safety equal to $4\frac{1}{4}$ in the first, and 4 in the second formula. This for a post 8×8 inches, 10 feet long, gives 68,000 pounds as the ultimate load, and 17,000 as the permissible load when the posts are straight and perfect, which is seldom the case.

Ecuador.

Issued by the Bureau of American Republics,
Washington, D. C.

The present Bulletin, No. 64, is, in character and completeness, the same as those hitherto issued by the Bureau, but relates to a country perhaps the least known among the Spanish-American Republics. It contains about 100,000 white people; about 600,000 Indians; a mixed race, or Mestigos, of 300,000; and a whole population, including negroes, of about 1,271,000.

The white people are highly civilized, and the management of the country seems to be as good, or indeed much better, than can be supposed with such a mixed population.

The book contains 177 pages, a good map, and numerous illustrations.

Former Clock and Watch Makers.

BY F. J. BRITTEN.

This book of 400 pages has been written by the author of the *Watch and Clock Maker's Handbook* to explain and preserve the history of clock and watch making in England, especially in London, where this art centered for some centuries.

Time-marking apparatus of all kinds has always been one in which more than any other the public take an interest. Every child for centuries past gazed for a first thing upon a clock, or a watch, listened to the tick, and when older was awed by the mysterious mechanism of the works; besides, the most consummate skill that mechanic art afforded has been lavished, if not wasted, on curious clocks. One recently exhibited here in San Francisco consumed fifteen years in its construction.

This popular curiosity concerning clocks has encouraged a literature greater in extent and more remarkable than in any other art so confined in its scope.

To the present work is appended a long list of the members of the clock-maker's company, running back for more than three centuries. These London guilds are little understood at this day. There were trade organizations to regulate prices, apprentices, and to insure honest work. Many of them are yet in existence, usually spoken of as the London companies. Some of them are exceedingly rich, and are also changed in their aims and character.

The present work is a history of famous clocks and clock makers, including in that term watches or pocket clocks, with drawings of the most noted designs and examples, also a description of escapements and other elementary parts.

It is a most readable book, understandable for everyone, and will serve to put on record hundreds of interesting facts that will have the same or a greater interest in time to come than they have now. The author could well supplement the book with one of modern practice under the factory system, but that would be more commercial in character, and lack the interest that attaches to the curious conceits wrought out by men operating independently.

The book is profusely illustrated, and is published by Messrs. Spon, of London, and Spon & Chamberlain, New York. The price is \$2.00.

The Indian Textile Journal.

The *Indian Textile Journal*, Bombay, India, a copy of which has come to hand, serves to show how completely the cotton manufactures of that distant country have been developed.

The Journal is produced with all possible furtherance of fine paper, print, general make up, also is for the greater part, or almost wholly indeed, originally written, and well written. The advertisements and commercial business represented are "Lancashire," reminding one that Bombay is as British as Manchester, and that the mills in Asia are an "annex" to those of Lancashire. It is all one system.

Theory and Construction of a Rational Heat Motor.

BY PROF. RUDOLPH DIESEL.

This work may be called an advanced study in the thermo dynamics of internal combustion engines, and a warrant of its value exists in the fact that it has been translated from the German language by Mr. Bryan Donkin, the author of our latest and most extensive treatise on gas engines, recently noticed in this department.

It is hardly to be expected that anyone not familiar with the subject here treated, would venture an opinion of professor Diesel's propositions and computations; but like

the engineer who critized the "shape of the smoke pipe" on a locomotive, we venture the opinion that an author who assembles his algebraic notation, like an index, on two pages at the beginning, will preserve an orderly course thereafter, and write as perspicuously as the subject will permit.

Speaking further in the same line, it is easy to skim over the pages of a popular book, and from a sentence here and there, learn the author's powers and qualifications, also to form an opinion of general merit as to scheme and treatment, but not so in the case of a technical treatise dealing with absolute or definite quantities as in this case.

Perhaps a page written here, would not so much as the following quoted paragraph, furnish an idea of the author's methods and purpose.

He says of steam engines :

"The utilisation of combustible in these motors is not carried out in accordance with any of our prescribed conditions, and the usual method of combustion is, in our opinion, erroneous. Firstly, the heat is added both to the air and to the steam at the wrong time, and increases their temperature; secondly, the quantities of air used for combustion are insufficient. To this must be added the loss of heat from the open furnace by radiation and conduction, and the heat lost up the chimney, whereby from 20 to 30 per cent. is wasted. With all these drawbacks, it is easy to understand why the most perfect types of steam engines and boilers only convert from 7 to 8 per cent. of the total heat of the fuel into useful work."

One object of the book, is to present a new method of generating power by "pulverized petroleum," in a four-cycle engine running at 300 revolutions per minute. It will be of especial interest and use to the makers of gas engines.

The book is sent by Messrs. Spon & Chamberlain, New York. Price \$2.50.

Belt Driving.

BY GEORGE HALLIDAY.

Messrs. Spon & Chamberlain, New York.

One in examining this book, is at first nonplussed by the title. Both terms are unusual, to say the least. "Belt" is a substitute for "band," and a poor one, because indicating an attribute or element of a circular figure. But "band" from German "bond" is relevant and the true word for

what Mr. Fairbairn called "wrapping connectors."

The other word "driving" is right enough when the work is examined, because it deals mainly with what may be called the dynamics of belt gearing, as compared to the making, nature, and use of bands for this method of transmitting power.

No one until examining this treatise, will conceive of the various forces and conditions set up in this kind of gearing, here resolved however in a manner as simple as is consistent with mathematical treatment, which is really the purpose of the work.

The subject matter consists in part of lectures delivered by the author, before the advanced classes of a technological college in London, consequently is carefully and systematically prepared.

It is a curious thing that the present method of treatment comprehends the two extremes, so to speak, elementary and advanced—elementary to discover premises, and advanced as to strains and results.

The book will constitute an invaluable reference in the present method of learning, and teaching mechanics, and its price, \$1.50, places it within the reach of almost everyone who can benefit by it. The article on half-crossed bands contains enough to reimburse the purchaser of the book.

Transactions of the American Institute of Electrical Engineers.

June and July, 1894.

RALPH W. POPE, SEC'Y

The most notable paper contained in the present report, is that of Mr. W. W. Griscom, on "Some Storage Battery Phenomena," accompanied by extensive diagrams, plotted to show the rate and phenomena of charge and discharge with different cells. It is an advanced paper on the subject, accompanied by a discussion in which Dr. Duncan, Mr. Townsend Wolcott, Sir David Solomons, and Mr. Frederick Rekenzaun are represented.

We also received advance copies of papers presented at the Chicago meeting of last month, one of which is indirectly noticed in another place in the present issue.

Of the proceedings, we can only say they continue to indicate the high standard and useful work of the society.

Report of the Smithsonian Institution for 1892.

The Annual Report of the Smithsonian Institution, now at hand, has the usual interest in respect to executive details, and a special interest in the technical work of the year. Among the articles contained in Prof. Langley's report that will have popular interest, we will name the following :

"Soaping Geysers," by Arnold Hague; "Pre-Columbian Copper Mining in North America," by R. L. Packard; "Present Problems in Evolution and Heredity," by H. F. Osborn; "The Empire of the Air," by L. P. Mouillard; "The Advent of Man in America," by A. de Quatrefages; "Primitive Industry," by Thomas Wilson; "Prehistoric New Mexican Pottery," by Henry Hales; "Relics of an Indian Hunting Ground," by Atreus Wanner; "Aboriginal Burial Mounds in Ohio," by R. J. Thompson; "Indian Remains on the Upper Yellowstone," by William S. Brackett; "The Birth of Invention," by Otis T. Mason; "The Inventors of the Telegraph and Telephone," by Thomas Gray; "Explorations in Mongolia and Tibet," by W. W. Rockhill.

Among these, and of absorbing interest, is that of Mouillard on "The Empire of the Air," translated from the French. We could easily make up this number of *INDUSTRY* from the present report, and feel that full justice was done to our readers.

The Smithsonian is a National institution at Washington, practically the chief scientific branch of the Government. It was founded in 1846, and is supported by money left to the United States for the purpose by

James Smithson, a distinguished English chemist, a natural son of Sir Hugh Smithson, who became Duke of Northumberland and took the name of Percy. Mr. Smithson was born in 1765, never married, and dying in 1829, left his fortune to his nephew, with reversion to the United States in case of his death without heirs. The nephew died in 1835, leaving no heirs, and the United States claimed the bequest. On September 1, 1838, \$515,169 was deposited in the mint on account of the bequest. Other gifts have been received, so that the endowments amounted in 1891 to about \$750,000.

Since then, Mr. Thomas George Hopkins, of Setauket, New York, has presented to the Smithsonian Institution the sum of \$200,000, the revenues of which are to be devoted to "the increase and diffusion of knowledge among men." This raises the endowment fund to nearly one million dollars. Besides the revenues of about \$100,000 a year from this fund, special appropriations are made by Congress, as the maintainance and work of the Institution may demand.

The work done is extremely diversified, so much so that it cannot well be defined within space here at command, and is but imperfectly understood. Most people regard the Institution as a kind of National ornament and attribute of dignity, and it is to some extent. It has one purpose apparent to all. The beautiful grounds and museum are an ornament to Washington, the only city in America that can lay much claim to beauty, as that term is commonly applied.

LOCAL NOTES.

There are signs, and some tokens of reform in the municipal administration of San Francisco. The organizations for public plunder have become so bold that the honest contingent has taken alarm, and out of a large number of candidates for municipal offices will, no doubt, select a better "crew" than has been in charge for ten years in the past. The political phase of the subject is not an issue at all, except as this term distinguishes between honesty and roguery. At least four parties are proclaiming their candidates as best and most capable, and this is the result of a pretended selection by ballot. Away back behind all these gruesome circumstances lies the main cause, in the sentiments and preferences of the people, although no one scarcely will admit that. From the fountain head comes a desire and passion for using the forms of law for personal and selfish ends, a sentiment of inequality under specious catching names, each cabal trying to gain the privileges of office and spoils. It causes one to think of Carlyle, the Czar, or any relief short of destruction.

There is a report, let us hope it is more, that a company or firm in England proposes to operate a line of steamships from Salinas Cruz, the western terminus of the Tehauntepec Railway, to San Francisco. If such a company was to go into the business, and maintain a constant and fair rate for carrying, it would be but a short time until a permanent business would result. The Tehauntepec road was offered some time ago to investors here in San Francisco, who at first entered with interest into the matter, and then weakened by fear of the "dominant power," as one may suppose. This is not the place to sell the Tehauntepec Railway, as President Diaz will find out. However desirable such an acquisition might be people are too irresolute to brave the railway power, and it is not to be wondered at when that power is considered. Nothing but a shameful want of public spirit could have brought about present circumstances, not only on the part of people here, but all over the country. There may be other reasons for the failure to secure the control of the Tehauntepec line, but the one named seems to be the main one.

In many of the principal thoroughfares of this City, especially California Street below Front Street, where there is no rear access to business houses, the sidewalks are daily blocked with merchandise. It is a shame, and is provincial. A merchant has to use his street front for shipping goods, and put his offices back in the rear end of his store where no one can find him without climbing over a lot of boxes and barrels. Anyone, no matter who, that will lay out a city without access to business houses except through their principal front is, if not a fool, the next thing to it. Suppose there existed here, as in many European cities, no right to put as much as a hat box on the sidewalks, and no right at all to move merchandise across the path of pedestrians. The movement of merchandise should be in and from the interior of squares, gaining thereby light, room, convenience and avoiding the obstruction of sidewalks. A warehouse in front and an office in the rear is a queer disposition of one's business.

The *California Architect* protests against the continuance of Federal fraud on San Francisco, by a faulty design for the United States post-office building, to be erected on the \$1,250,000 site purchased two years ago. The architects are the best judges of this matter, also of the method by which designs for Federal buildings are produced, and we feel much like accepting their criticisms, in fact we should accept almost anything, after the methods by which the land was acquired. A Bureau at Washington to design public buildings, naturally falls into routine, and follows on antiquated lines, and there certainly should in this, as in other public matters, be some way of calling in a consensus of opinions and a combination of professional skill. The post-office building will, however, present an engineering problem below ground, as extensive or more so, than the superstructure, and this too will be a proper subject for criticism.

Mr. C. E. Grunsky, C. E., of this City, President of the Technical Society of the Pacific Coast, has been nominated by some party, no doubt the best one, as a candidate for Superintendent of Streets in the City of San Francisco. We confess to having, so far as possible, opposed such a nomination, for the reason that it seemed to be dragging a man of exceptionally high standing, professionally and socially, into what is called "politics." Mr. Grunsky, as our readers will remember, with Mr. Marsden Manson, formed the active

members of the "Sewer Commission," composed of able engineers, who were "squelched" by the political exigencies of the municipal power last year. Messrs. Manson and Grunsky had the audacity to return to the public funds a considerable portion of the appropriation for their work, not used, also temerity to expose the scandalous work done by contractors on the City sewers, and for this suffered official annihilation. Now that Mr. Grunsky has been formally nominated, a failure to elect him will indicate an indifference of the citizens to the interests of the City. There is, perhaps, no engineer in this City so well qualified for the administration of this office, or who would more conscientiously carry out the responsible duties connected with it. Both the nomination and his acceptance of it are hopeful signs for the future.

Mr. Oliver Everett, Secretary of the San Francisco Chapter of the American Institute of Architects sends the following :

At the regular monthly meeting of the San Francisco Chapter of the American Institute of Architects, held Oct. 19th, the following preamble and resolution were unanimously adopted :

"Whereas the needs of this City demand that the streets and sewers be placed under competent engineering supervision, and as the California Association of Civil Engineers has put forward one of its most prominent members, Mr. C. E. Grunsky, as a candidate for Superintendent of Streets,

"Be it therefore, *Resolved*, that the San Francisco Chapter of the American Institute of Architects endorse the candidature of Mr. C. E. Grunsky for the position of Superintendent of Streets, and place itself on record as to the vital importance to the building and business interests of our streets and sewers being under the supervision of competent professional engineers."

The Pelton Water Wheel Company have issued a new circular or catalogue of their wheels and other manufactures, a sixth edition, and by far the most complete of the kind that has ever been produced relating to the tangential system. The book of 100 pages, 7 × 10 inches, is to a great extent a hydraulic treatise, furnishing technical information respecting various subjects connected with water and hydraulic apparatus of all kinds. There is included drawings and particulars of various water-power plants erected by the Company. Illustrated among these is a wheel 36 inches in diameter at Virginia, Nevada, under a head of 2,100 feet, or 911

pounds per inch. This wheel is driven at the rate of 10,804 feet per minute at the periphery, and, no doubt, under the highest pressure ever applied on a water wheel. The nozzle or jet is only half an inch in diameter, and produces 100 horse power. In Europe many Pelton wheels made here, are employed under a pressure of 700 pounds per inch.

The Hartford Steam Boiler Inspection and Insurance Company do an enormous business. Messrs. Mann & Wilson, of this City, the agents here, furnish us reports of the business each month; such a report now at hand shows for a single month, 7,467 inspections, which included 13,391 steam boilers. The defects reported were 11,308, of which 976 were dangerous, and twenty-five boilers were condemned. The following are some of the items classed under defects: incrustation, 1,903; internal corrosion, 630; deposit of sediment, 840; defective riveting, 1,600; leakage, 1,656; defective gauges, 525, and so on up to 11,308. The wonder is that under such circumstances the population of a country should increase. The report seems incredible as to the enormous proportion of defects, but is unquestionable, and argues a recklessness that would be still greater were it not for the efforts of this company.

The H. N. Cook Company, of this City, last month executed an order for which there is, perhaps, no parallel in the leather-belt-ing trade. The order was telegraphed from China for 25,000 feet of $2\frac{1}{4}$ inch belting, nearly $4\frac{3}{4}$ miles of it. The intended use is not known, but it is doubtless for some purpose in army equipment. Fortunately the resources of the establishment were equal to the requirements, and the whole of the 25,000 feet went off on the first steamer, sailing a fortnight later. The Company have recently added some important machines to facilitate and improve their manufactures, notably apparatus for stretching uniformly the hides from which belt sections are cut. These machines are the subject of patents now pending, and consequently should not be described. The business, as a whole, is an example of what can be done here in organized manufacture. A portion of the product is now being shipped to the Eastern States.

The Judson Dynamite and Powder Co., of this City, have removed their offices to 200 Market Street, into more commodious

quarters, which means progression in one of our most important industries. The company since its organization three years ago, has been conducted in a very successful manner as a thoroughly organized business, by experienced men, and serves as a model for numerous possibilities in manufacturing on this Coast. It is true there is a wide market for explosives here, but this is a small matter compared to the inception and vigorous prosecution of a business, under good administration. Perhaps no business presents more difficulties. It is continually disturbed by changes, inventions, and adaptations of one kind or another, still it stands as an example of what can be done in manufactures here. The extensive new works of the company in Contra Costa County, are situated in a place where accidents, if they should occur, can do no more than local damage.

On the trial trips with the *Oregon*, the first was made with 2,000 horse power, and 1,000 horse power was added on each succeeding run up to 10,000 horse power, without, as Mr. Dickie says; "any hitch even of the slightest character." What this means can be realized only by spending some hours in surveying the mass of mechanism set in motion. It is commonly a feat of congratulation to have a single steam engine, or other machine, start without a "hitch," but here is an aggregation equal to the fittings of several great factories set in motion for the first time, crowded into scant room, to withstand rolling about, held by a structure having many other functions. It seems an impossible feat. For three years 750 men have labored on this work, and 1,250 men have been six years on the various war vessels built at the Union Iron Works. The character of the work we commented upon last month, and can add nothing more. It has called out skill that must remain a prominent factor in the future industries of this Coast.

There is a good deal of difference between making the details of a warship and assembling one. The Union Iron Works here is about the only place in the world where a ship is wholly produced in the works. The *Oregon*, for example, contains 120 steam engines, every one of which was made in the Union Iron Works, while the sister ship, constructed by the Cramp Company at Philadelphia, contains 72 engines made by other firms. Not only this, nearly all the steam and water fittings, the whole of the hydraulic

apparatus, and indeed nearly every detail of all the ships built here are produced in the works at the Potrero. Even the electric lighting plant was put in by the contractors, who purchased only the dynamos and other elements that could not be produced by the resources of their own establishment. This is a very important fact in respect to the Union Iron Works, and indicates an ability of staff, plant and administration without parallel.

There are as many ways of noticing a new book as there are of framing a political platform. The most common is to lay it away until you see what others say concerning it. This is the lazy and incompetent method, and it is only just to a publisher to fire away and write your impressions when the book is received. One fortunate circumstance is that there is scarcely any book of a technical nature that is not worth its price, even if it is full of errors, in fact a chief value may be in this if the reader detects them, because he goes on to investigate, and calls out his own resources. Speaking of errors, the reviewer is placed in a position of much risk, because an average editor can no more read a technical book "critically" than he can write a long article outside of his own business. One other thing that may be mentioned is that an author's name commonly indicates the relative amounts of "grain" and "chaff." Some produce one, some the other.

There is a branch of modern serial literature that has not yet in the course of evolution taken hold of popular opinion or popular appreciation, that of a compendious review, such as occupies a considerable portion of the *Engineering Magazine* for October. The preparation of subject matter each month to embrace all of the more important essays in technical and industrial publications is tedious and expensive, calling for diverse and competent knowledge of the matter dealt with, and a great amount of routine labor thereby removed from the shoulders of the reader. It is an extreme example of "double use," whereby a reader can with a single publication in his hand sit and look over the whole field for the month, and thus do work in an hour that would require days in a library, or incur an impossible expense in subscription. The publishers of the *Engineering Magazine* deserve much commendation in furnishing as an adjunct to their journal that which alone is worth ten times the subscription price.

Mr. W. H. Dodge, the founder of the Dodge Manufacturing Company, at Mishawaka, Indiana, died at that place on September 10th, at the early age of 45. He was an energetic man, who added several branches of new manufacture to our industries, among them wooden belt pulleys now so well known; also rope driving by means of continuous winding, so the rope was in one piece and the strain of all the strands or wraps taken up by a tension pulley. It is hard to estimate, unless one lives there, the effect produced in a small city by founding a large manufacture, the products of which go out into the world's markets. It leads to a sufficient and very equal distribution of wealth, to inter-acquaintance and the social advancement of the people in every way, and the founder of such a business when a worthy man, has accomplished one of the highest of human aims. This was Mr. Dodge's mission and work, well performed.

There is a report that a new technical and industrial magazine is to be founded in San Francisco under the auspices of the Mechanics' Institute. We do not question or disparage the right of any person to found such a serial at their own risk, but when it comes to using the name and funds or patronage of the Mechanics' Institute for such a purpose we do object, and vigorously. There is no need of producing literature in this manner so long as the same thing is done by private and independent investment. We have recently witnessed the end of a San Francisco magazine for which people unwittingly paid a bonus of not less than \$60,000, a most unfair kind of competition in journalism. We are not complaining in respect to *INDUSTRY*. It never used a gratuitous dollar, published a "write up," or sought adventitious aid, or any other kind of aid except fair patronage. When it was founded the sum in cash required to start the Journal was paid into the bank from honestly-earned money, and drawn from until exhausted, then another sum was added until a foundation was laid. We therefore claim that the Mechanics' Institute has no right to appropriate funds or patronage for the purpose of promoting a journal published in private interests, any more than to extend such aid to any mechanical or mercantile business represented in the membership.

The proposed magazine of the Mechanics' Institute has a counterpart in an illustrated history of the University of California, to be published by a private firm on the subscription method. The sub-

ject matter and main elements of this work will, no doubt, be contributed by the University itself, and the publication should have emanated from the same source without a subscription scheme. Such enterprises are unfair, and discourage independent business. In the present case we are asked to send two dollars to purchase a copy of the history for "review." We do not purchase books for notice in our review columns, and hope that no one else does. We will be glad at any time to do anything within the province of the Journal to promote the educational interests of the country or its institutions, but not to purchase for review subscription books published in a private interest.

We have received from Mr. N. D. C. Hodges, the publisher of *Science*, which suspended in March last, an invitation to contribute to its rehabilitation under the encouragement of a subsidy from the American Society for the Advancement of Science. It is needless to say we are opposed to subsidies of all kinds, and that it is hard enough to conduct an independent journal against the unfair competition due to the sale of their reading columns by many contemporary publications, and certainly cannot contribute to any other journal, much less a subsidized one. There is a further objection. The kind of science to be promoted, laudable as it may be, is not that kind which we are most interested in. It fails to deal with computed quantities, and promotes a kind of knowledge suited for those of leisure and wealth, who do not want to be bothered with things requiring proof. Our kind of science deals with grosser things, such as are weighed, measured and applied.

COMMENTS.

Who, among our readers, will know there are thirty-six cotton mills in Japan, and that the Bombay mills in India look there for competition? The cotton consumed in the month of March, this year, was 10,523,160 pounds, spun on 385,263 spindles. Not only this, coal is exported from Japan to Bombay mills, and a vigorous competition is, no doubt, to come in future. The *Indian Textile Journal*, from which our figures are taken, speaks of a recent meet-

ing of the Japan Cotton Spinners' Association to frame rules under which export orders from China should be filled. This was, of course, before the war. The following are the rules :

“(1) The quality of the yarn exported should be very fine. (2) Each bundle of yarn should weigh 10 pounds. (3) Each bale should contain either forty or twenty bundles. (4) A ticket supplied by the Association to be fixed to each bundle in addition to the exporter's table.”

That is an example of straightforward business. It would take a page of matter to say this in most other countries.

The founding of new textile industries in the face of their “destruction by a reduction of custom duties” is not easy to explain, except by assuming that the protests and statements of manufacturers are insincere and for effect. The *American Wool and Cotton Reporter* in its reports of new investments in mills shows that in six months, ending with June of this year, 116 new mills were founded against 127 for the same period in 1893. This indicates not only a disregard of duties, but is anomalous in respect to the depression of business, also shows that no one thinks our manufactures are going to ruin. Men do not invest their money where they think it will be lost, no matter what their utterances may be to influence legislation. We have just been going over the reports of the Senate Committee on tariff inquiries and answers of woolen manufacturers to the circulars sent out. The opinions are interesting, but evidently are in many cases nothing more.

Now that the smoke has cleared away, and the newspaper clamor subsided, the facts of the great naval battle at Yalu, off the Corean coast, begins to appear under authority, and are deplorable enough even with this qualification. In no case this far has any engagement of modern warships compared with this Asiatic conflict, and we question if there ever will in European hands. It settles at once the courage of the Mongolian people, and indicates a possible place they may assume in future, if drawn into war. The Chinese squadron consisted of five armored and seven unarmored ships, of these, four were destroyed, and all the rest, save one, disabled. The Japanese had three armored ships and eight unarmored, and while none were sunk or lost, all of them received a terrible hammering. The *Yoshino*, of 4,150 tons, being badly injured. The

Chinese twelve ships foot up 36,125 tons, and the Japanese eleven ships 36,414 tons, the two forces being almost precisely equal in this respect.

A patriotic company in Chicago offer to construct another railway across the continent if the Government will loan them, that is guarantee, their bonds at the rate of \$148,000 a mile. Leaving out the sublime impudence of asking the Government to furnish the money to construct a railway where there are now three or four not needed, and one at least made in the same manner suggested, there is the natural query of what the new company propose to do themselves, and on what grounds they propose to become the custodians of \$400,000,000 of Government money. We have not seen the prospectus of this proposed company and scheme, and would doubt its existence if it were not credited to Chicago. We need here for some time to come, perhaps for all time, the New Zealand provision that the Government's credit shall not be used for any purpose whatever.

Mr. Hiram Maxim, in the *North American Review* for September of this year, has given a full and very interesting account of his experiments with aerial machines, for the first time so far as we know, describing the construction of the various elements that compose his present apparatus, including the steam engine, boiler and other parts. We regret that our space will not permit the reproduction of the principal facts and dimensions, they indicate great ingenuity. In a late letter of Mr. Maxim's he gives answer to a question often asked: What is a flying machine for? He says that "the European nation that takes advantage of this new engine of destruction will be able to modify the map of Europe according to its own ideas." It is then a machine of destruction, to enable the killing of people under unequal chances, and the conquest of governments. Mr. Maxim has devoted most of his energies to machines of destruction, which may be laudable, but we cannot think so.

It is reported that the United States Patent Office has refused to grant a patent to Mr. H. Maxim on his flying machine on the grounds of its not being useful or practicable, and demands a model to demonstrate the latter qualification. We do not believe Mr. Maxim wants a patent on his machine, and if an application

has been made there is some other object. The demand for working demonstration is a new feature in procedure, because as a rule inventors are not permitted to present machinery to demonstrate the "practicability" of its operation. Mr. Maxim does not need a patent on his contrivances. No one not a millionaire is likely to imitate them, and not in any case so as to injure his interests. There should be no restriction on flying machines as a protection to inventors, but if some kind of fundamental claim could be granted to deter people from making such apparatus it would be highly beneficial to most of those engaged in that way.

Prof. Von Holst, of the University of Chicago, contributes the leading article in the last number of the *Journal of Political Economy*, rebuking those addle-headed optimists who when the country was filled with riots were arguing that anarchy could not exist here. Prof. Von Holst's theme is the aggression of organized labor, and its dangers to law and order, an able defense of the monopolistic power, but will fall far short of good reasoning in the estimate of most people. It is an assumption of innate wickedness and ignorance on the part of the labor organizations, and begins with strikes and disorder, instead of the causes of strikes and disorder. He splits the premises in the middle, and deals with the second half, ignoring the first part, and assumes by implication, if not by direct words, that the labor organizations cannot be trusted to make or execute laws, or with public peace, and is amazed at toleration of them. This very toleration, bad as it may be, is proof that Prof. Holst's views are not held by any considerable part of the people in this country.

The development, or, as we may say, the creation of water-carried commerce on the American Lakes is a most extraordinary feature in the economic history of the country. The number of vessels constructed during five years past is 991, and their tonnage 471,891. The added freight to employ such a fleet as this has been principally iron ore, wheat and coal, with the normal increase in all other branches of trade. The total tonnage of the Lakes is 1,261,067, so that more than one fourth in value, and perhaps one third in value, has been added in five years past. This shows what can be done in this country under equal chances. The oceans would be covered in a similar manner with American shipping if

there were equal chances with other countries in respect to taxes and dues, cost of material and the encouragement of being let alone. On the Lakes, or in the inland waters of the country, shipping is operated under a scale of values and earnings that compensate for the higher first cost and systems of taxation, thus placing owners on an even footing, so to speak.

In going over the technical and trade serials of this and other countries during twenty years past, one can easily recall the great change that has taken place, indicating more than anything else the advancement made in applied science and the mechanic arts. Our foreign exchanges become of less value relatively, and the American ones better. It is true there is less concentration. None of our journals have the resources or can spend in their make up so much money as the German *Zeitschrift*, *Genie Civil*, *Engineer*, *Engineering*, and other notable European journals, but collectively there is more in the American journals of a practical or applied nature. There is not, perhaps, a decadence in European serials, which are well maintained, but improvement here, notably in dress, diversity and originality. For secular newspapers no such claim can be made, they grow larger and less reliable.

The value of press news can be judged by the following: (1) "The feature of the Victorian elections, held last week, was the annihilation of the free-trade party, which rallied for the first time in ten years." (2) "The Government has been able to retain only twenty-one parliamentary seats out of eighty-eight, the opposition securing fifty-four, and the independents thirteen. A free-trade victory in Pennsylvania would be less remarkable." These two extracts are from the two principal morning papers of this City, giving an account of the recent election in Victoria, Australia. Contemporary news indicates that the first account is simply falsehood told to be swallowed by a clientele that are as credulous as ignorant, and the contradiction illustrates what dependence can be placed in the average newspaper of our time.

Although the *Vesuvius* has proved a failure, and is to be converted into a gunboat, the dynamite-gun matter has not been abandoned, and large guns or tubes for throwing shells filled with

dynamite are contracted for, the first to be erected at the entrance to New York harbor. The guns are of fifteen inches bore, and some recent experiments made indicate the practicability of throwing five hundred pounds of dynamite by air pressure to a distance of a mile and a half, and fifty pounds three and a half miles. San Francisco is well situated for defense of this kind should it ever be needed, that is if we suppose a hostile vessel should want to enter the Bay. The risk of discharging dynamite in any of its present known forms is explosion by concussion before the charge leaves the gun or tube, and of this we should not be too sanguine, because the idea is not new, and the experiments very few to this time. One premature explosion of a five hundred pound shell would settle the matter forever.

The Prosser Falls Irrigation Company, in Yakima County, Washington, have erected a piston pumping plant to raise 6,000 gallons per minute 110 feet high, employing pressure turbine wheels for motive power. Such a plant is very expensive, and liable to deterioration, and if profitable for any kind of common agriculture, what can be said of hundreds of square miles of rich land lying less than thirty feet above lakes and rivers here in California? It is true that water power is wanting, and fuel is dear, but the difference between 110 feet and 30 feet would compensate for this where centrifugal pumping is practicable, at one fourth the cost of the Washington plant, and almost exempt from deterioration or expense of maintenance. Some years ago an enterprising firm here began a scheme to irrigate a large area on the south bank of the San Joaquin River, and to purchase dry lands to be sold again. The original owners of the land found out what was going on, and quadrupled the price at once.

U. S. Consul E. W. S. Tringle writes to the State Department in respect to an export trade in American cabinet ware, and raises a question that needs solution. Nowhere else in the world is there so much timber, or so cheap, and in no other countries are the processes of manufacture carried on so cheaply. Yet, for some reason, American manufacturers of cabinet ware do not build up a large foreign trade. The art of "knock down" packing is also a peculiarity in the trade here, carried out to the fullest extent, so that bulk is not an impediment to trans-sea shipment. Everyone who has purchased cabinet furniture in Europe knows it is very much

dearer than in this country, and the inference is that no proper effort has been made here to establish foreign trade in this line. One impediment may be that the designs and methods of construction would have to be modified for most other countries, but this is true of all other manufactures. The main thing wanting is, no doubt, attention to the matter.

The *Nation* thinks the Naval Observatory at Washington should be reformed, and then moved to New York, or both at once, and for very good reasons. Such a proceeding is in part prospective. The Secretary of the Navy has instituted some changes that will separate the astronomical section from the mechanical one. The astronomical part is an assumption at any rate in so far as abstract observations, the legal functions being to prepare charts, store and care for and adjust nautical instruments for naval service. As Washington is so situated that ships do not sail from there when sent on cruises, instruments have to be carried by train to New York, or elsewhere on the main coast, and a journey of this kind is not likely to improve the condition of chronometers and other instruments of precision. There is now to be a naval officer "in charge," but a civil officer or director in control of all executive work. It is very much like the management of a man-of-war, and incomprehensible in a business sense.

The Brooks Locomotive Works, at Dunkirk, New York, have been the fortunate contractors for sixty locomotives for a railway in Brazil. The contract was made in June last through Messrs. Flint & Co., of New York, and part of the engines have been sent forward. By transacting a portion of the business by telegraph enough time was saved in construction to permit the engines now sent, to be forwarded across the Atlantic Ocean to England, and then back again to Brazil, gaining thereby, as the *Iron Age* states, from thirty to forty per cent. in freight, also says it is to be hoped a larger trade to South America will enable lower rates by direct lines. But it is not volume that is needed, it is something else. We want less taxes on ships, less dues of all kinds, and cheap material to construct them of, or, in other words, we want, like the Hamburg "Kauffman's Verein's" resolution on German shipping, our shipping "to be let alone." This method of shipment from New York to Rio Janeiro, via England, will most likely send the next order for locomotives there instead of to this country.

One must be amused at the opinions and news published by our friends on the northern side respecting the timber business of the Sound. The Chamber of Commerce at Seattle, while the Wilson Bill was pending, passed vigorous resolutions declaring the timber business would be ruined by a repeal of the duties. This was paraded by a Seattle journal that last month said: "More than fifty vessels are loading for Valparaiso. Orders from China and Australia have increased forty-five per cent. As a result the Puget Sound Mill at Port Gamble has started in full blast. The one at Port Ludlow will soon do likewise. Port Blakely has been running night and day for two weeks." If this is the effect of free trade in timber our Washington friends could stand a good deal of it. The new method of taxation in New South Wales, or rather the return to the old method, is one cause of the improved Sound timber trade.

The following from the *Boston Herald*, and also from the U. S. Consular Reports, in respect to railway construction in New Zealand, contains an important suggestion:

"Works like railways and highways, which were constructed by the General Government, were divided up into small sections by the Government engineer in charge. Each section would be appointed to a group of laborers, six or eight in number, who would agree to do the work for the sum estimated by the engineer. The men would elect one of their number to transact the business for them. The group would do the work in its own way, but its members would, of course, receive a greater remuneration for their time, the sooner they finished it. If the men did not own the tools necessary to the work, the Government would lend them and charge for their use. The Government would, from time to time, advance money to the men, sufficient for the maintenance of their families, and on the completion of the job and its approval by the engineer, would make the payment in full. In this way the men would get for themselves the profit that would otherwise go to the contractor."

Mr. Thos. L. Green, in the *Engineering Magazine*, has some sensible remarks on ornate sleeping and other high class cars, that cost \$25,000 to \$30,000 each. The decoration of a modern sleeping car is out of taste, and in keeping with the nickel plated locomotives, and red, white and blue machine paints of twenty-five years ago. Half the cost has no reference to comfort, indeed is quite the reverse. Not one in ten who ride in these fine cars, have such decoration and luxuries at home, and do not care for them. Much more to the

purpose would be some way of opening the windows downward, six inches added to the width of the seats, some kind of back and head rest, and some place to stow personal effects. There might also be some convenient way of getting into and out of the cars, protection from peddlers, lights that one could read by at night, and an end of ticket punching under-way. These are matters of comfort that can not be balanced with fresco work, silver plating, embossed panels and glitter.

ENGINEERING NOTES.

Notice of a large broach made in Philadelphia, over four feet long, to prepare holes 3 inches square, reminds us of a similar operation witnessed a good many years ago, at the Enfield Rifle Factory, in England. The broaches there were smaller, about 30 inches long, and less ingeniously constructed, but there was one feature not included in the Philadelphia case. The broaches, or "drifts" as they are sometimes called, were pulled through the same, but under water, or soap and water, which seemed to add a great deal to the operation. The implements and work were put into a trough, having a chain and hydraulic piston at one end for pulling. Connected with the trough was a tank of equal size, to which the soap and water could be instantly transferred, by some means not now remembered. When the broach was set, the trough was flooded, and the drawing began. The work done was the finest imaginable, true, polished and cheap.

The makers of steel castings and forgings in England find it profitable, or at least expedient, to finish, or partially finish, their work so they may detect any want or imperfection before the pieces leave the works. Messrs. William Jessop & Sons, of Sheffield, recently added to their equipment a number of powerful machine tools large enough to prepare marine cranks and other work of all kinds. As this preliminary work costs no more when done by the steel makers, the weight reduced, the "chips" left at the works, and the quality of the work assured, it seems a very judicious and economical method, but must add a great deal to the investment. In the case of Messrs. Jessop & Sons some new tools recently added must have cost not less than \$5,000 each, but the firm's enormous business permits whatever will insure excellence.

Mr. Elmer A. Sperry presented at the Chicago meeting of the American Institute of Electrical Engineers, on Sept. 19, an interesting and valuable paper on electric brakes for street railway carriages or motors. The paper was valuable in two ways, and, as we think, especially in showing the faults and shortcomings of the methods in present use. He says that while all kinds of advancement has been going on in the art of constructing and operating electrical railways, little or nothing has been done in respect to means of braking or suddenly stopping the cars. The result is a continual recurrence of causalities all over the country that demand instant attention. The inadequacy of friction brakes pressed against the wheels by hand power in imitation of a country wagon, almost the only method in use, is sufficiently shown by its abandonment long ago on the general railways of all countries, but it is retained on urban or street lines where there is a much greater need of efficient brake force.

Mr. Sperry, in his paper above mentioned, proposes an electric brake too intricate or technical in nature to be described here, and respecting which we must refer our readers to the paper itself, but the main point is that electrical or other, the street railway lines should be compelled to adopt means of stopping their cars within or near the limit that tractive force will overcome the momentum of cars. The author says, and very truly, "it may not be known that under proper and standard conditions any car or train may be brought from a speed of ten miles an hour to absolute rest inside of ten feet," also "that a wheel brake can accomplish this," not a common wheel brake, however, but a possible one. When brakes are applied, the tractive resistance, especially in electric cars, is far below the center of gravity, and the car pitches forward on the foremost wheels, almost lifting the rear ones from the rails. In this way one half of the brake friction is lost. Mr. Sperry proposes, for one thing, that the forward and rear wheels should be connected by links.

Reverting still to brakes, it seems a strange thing that mechanical contrivances cannot be made to transfer the weight of a car to shoes on the ways. The track brake, as it is called, now in use on some of the cable lines here in San Francisco, was such a brake, and, as we believe, a most effective one, but had the fault of being central on the cars, and was not set by their momentum, or by a toggle. The proper place for a brake of the kind is in front of the leading

wheels, and if the cars are reversed would have in that case to be at both ends. We are not inventing brakes, however, but pointing out that it is high time some one else done so for street railways. As at first remarked, it seems a strange matter that with ample force, both rectilinear and rotary, at command, ingenuity has not furnished some way of producing tractive resistance corresponding to and performed by the weight of cars.

It is curious that the general efficiency of railway brakes may indirectly lead to accident, but such is the case. At the St. Pancreas Station, in London, a passenger train recently ran into the "buffers" with such force as to smash the connections throughout the train, break up some of the carriages, or at least crush them in and injure a number of passengers. The brakes employed are so efficient, that the trains are run close up to the station, at a rate of 10 to 15 miles an hour, and stopped without trouble, but in the case above named, two "fish trains" from the coast had been run in on the same rails, and the water from the fish cases had drained down on the rails, leaving them the same as if thoroughly oiled. The result was that the train fully held by continuous brakes, slid over the rails, and struck the buffers at seven miles an hour, with the result above named.

Some one has been at the trouble, and it is a good deal, to add to engine lathes a barrow load of details to attain automatically an uniform cutting speed. It is an ideal condition, but "costs more than it comes to." At least ten years ago, perhaps twenty years ago, a few makers arranged the first wheel, on what is called the poppet spindle, to move sidewise and gear with either the cone pulleys or the main spindle. This was a most useful feature, costing two or three dollars, but is found on but few lathes. About the same time Harvey Bros., of Glasgow, introduced a second pair of wheels in the back gearing of common lathes, another feature of much practical value, but has not spread much, although it gave complete control of power and saved the belts. Even sooner Mr. F. B. Miles, of Bement, Miles & Co., Philadelphia, made his cone pulleys parallel, and in such a manner as to not injure the belts, a simple and perfect invention, but no one, or at least few, uses it, so we must conclude that the scheme at first mentioned will find slow favor among tool makers.

Screw shafts are turned in the Clyde shipyards at no cost at all, and when turned are cheaper than if left rough. Powerful lathes with four tools are employed for rough turning, and the chips cut off pay for wages, power, interest on the investment, rent, and all other expense, leaving, besides, a margin of profit. This is not the only case of the kind. There are certain kinds of work done by "premium apprentices" wherein the product is cheaper than the rough or crude form. Vice screws are one of these things. This is, of course, an accident, due to a system where premiums are paid for apprentices, and the parents of the apprentices foot the cost of the work, still it must be taken into account in dealing with improved implements. A Birmingham firm who were once offered a machine for rapidly-cutting threads on vice screws said, we do not want it. We are now paid for the privilege of making such screws. It was a job selected for the premium apprentices.

Mr. Wm. H. Wood writes to the *Iron Age* that his father, Mr. James H. Wood, was the inventor of the process of compressing fluid or molten metal in the manner adopted in late years by Sir Joseph Whitworth & Co., and that this process was successfully applied by his father at Manchester and at Birmingham, also that the writer accompanied his father on a visit and interview with Sir Joseph Whitworth at his works in Manchester when the process was fully explained. Mr. Wood employed screws instead of hydraulic pistons to compress the metal for copper calico printing rollers, that required to be very solid and homogeneous, so as to receive the fine figures cut on the surface for the printing process. We do not know that Sir Joseph Whitworth, or any of his people, ever claimed to be the inventor of this process, and doubt if Mr. Wood has. The product at Whitworth's was called "fluid compressed steel," and any patent thereon related to either the product or to apparatus, not the process.

The reduction of the duty on tin plates does not seem to discourage the manufacture in this country, on the contrary seems to have given especial impetus to plate rolling. Several new mills are announced, among them one at Cleveland, Ohio, with a capital of \$200,000. The founding of mills to roll the plates for tin means a great deal more than coating or dipping enterprises, which do not involve much skill, or, at least, employ only a low grade of labor. The work is dirty, unhealthy, and involves no other quality than

endurance and manual dexterity on the part of workmen. The manufacture of the iron or steel plates is a different matter, and while there has been no important invention or change in the methods of rolling sheet metal, it is an industry that must sometime become extensively carried on in this country. We, some years ago, visited a rolling mill at Sheffield, England, where sheet steel for pens was rolled. It was an interesting process, but the final rolling of such sheets is done cold at the pen factories, the strips being about eight inches wide, and annealed several times between the rollings.

The *Engineer*, London, in a late article on vibration in steamships points out as a disturbing strain the pressure up and down on the cylinder covers, and thus introduces with some complication the old proposition of persons lifting themselves by their boot straps. The writer says "the effect on the cylinder covers is simple and straightforward, the way in which it is taken up is complex." While not doubting that some analysis of the matter must lie behind a proposition of this kind from so high an authority, it is in controversion of the common idea that such strains are inherent in the engine and its framing, and that any departure from this assumption must be in considering the shaft as a lever and its bearings fulcrum. We mention the matter here because it is the best problem for engineering students that has appeared for a long time, and we will be glad to receive and publish any intelligent communication on the subject.

Judging from such published literature as is commonly known, and from a considerable amount of observation through the mountains of this State, we doubt the methods of civil engineering education as being competent to deal with common roads. It is a study by itself, and must be one of "roads"—not "books." The *American Engineer*, in a late issue, has hit upon the happy term of "academic" as applied to road literature. It fits precisely. No one doubts that a good road can be made on academic plans, but everyone who has observed mountain roads in this country knows they cannot be made in this way. We have just driven over a toll road rising 2,400 feet in six to eight miles, on a very uniform grade, but it had not a watering place in all that distance. The weather was warm and the trip came near costing a valuable horse. The mountain or grade sections are best, and the level sections abominable, and this is true of most of our country roads.

At the late meeting of the Master Mechanics' Association a consensus of opinions respecting compound locomotives was decidedly favorable, and significant in the fact that repairs, economy of fuel, performance, and other conditions were taken into account. Compounding alters a locomotive a great deal, not only in construction, but in various other features, and no consideration of the system has much value if based upon economy of fuel, or any other single feature. Mr. Forney remarks upon this subject in commenting on the discussion of compound locomotives above referred to, and in respect to data from simple engines :

"If these figures can be relied on, and we understand that the authorities of the New York Central Road are prepared to back them up, then the advocates of the compound engines must, in order to sustain their claims of a saving of from 15 to 30 per cent. of fuel, be able to haul trains weighing more than twice as much as the engine and tender at average speeds of over 50 miles per hour, with a consumption of coal of 2.262 to 1.864 ounces per ton per mile. Who can do this?"

ELECTRICITY.

NOTES.

There is great activity now in inventing improvements in electrical storage batteries, especially in Europe, and some promise of lessening the weight, which is a principal objection for traction purposes at least. A French battery is made with carbon plates, composed of two parts carbon, one part lampblack and a little flour paste, mixed at a high temperature, and while soft rolled into sheets to be cut out in the desired form for grids. These are baked at high temperature, cooled slowly, and then covered with litharge. These plates are claimed to be far superior to those of lead, and are not attacked by the acid solution. The active material, peroxide of lead, is applied by any of the common methods. Such plates must be a good deal more expensive than lead, but if they do not buckle, and have the same functions, they are certainly better for a good many purposes. We much doubt, however, if they will act the same as lead.

In a communication from Mr. Edgar H. Booth, of the General Electric Company, he sends tabulated observations of a test for efficiency made with an electric haulage plant, constructed for the

Cleveland Iron Mining Company. The observations were taken from the engine indicator cards, and the draught of the electric locomotives show an efficiency of 58.2 per cent. of the haulage system from the engine to the draw bar, and dynamometer on the electric locomotives. This seems an extraordinary result, considering the circumstances of underground haulage, and has determined an extensive application of the same system now in preparation for that company. The increased economy of electrical transmission has during two years past come about in a quiet way and has gained confidence accordingly. Not only had the method to reach other systems of transmission, but to overtake them in a rapid race toward higher efficiency.

In a recently fitted up electric plant, at Portsmouth, England, a Parson's steam turbine of 200 horse power is employed to drive the generator. The wheel revolves at 3,000 revolutions per minute, and is geared directly to a two pole armature, giving 75 amperes at 2,000 volts. This is the largest direct impulse engine ever made, and as the work was erected from plans by Mr. Ferranti, we may reasonably conclude that the steam engine or wheel gives out a fair efficiency. The steam turbine is "coming," and promises now a fruitful field for inventors, but not for contrivers. It is a machine born of scientific inference, so to speak, and will be developed in that way. We do not allude to its mechanism, reducing gearing and so on, but to the steam and thermal problems involved.

MINING.

NOTES.

The New York *Sun* has always had a weakness for mechanical matters, and if let alone by our friend Mr. Watson, of the *Engineer*, who abides near by, there would be a comic department in technical literature. The last discovery of the *Sun* is a mining plant where the cages are raised by a water balance, a rope over a large pulley, and a water tank sent down to pull the ore up; but there is mention of a valve to permit the escape of the water at the bottom of the mine, and no explanation of how the water is got back to the surface. The method in its main features has the advantage of being some centuries old, consequently is not to be doubted. The *Sun* specifies gold mines, and perhaps refers to raising gold by a water-

balance rig. If so, the gold would be valuable enough to pay for pumping the water out and leave a margin of profit, or the water may be evaporated, and rise out of the mine by its own volition.

The *Engineering and Mining Journal* comments severely and justly in some respects upon the fact of several of the Cœur d'Alene mining companies signing a contract that concedes certain terms and stipulations of the Miner's Union at that place. It is pretty hard, however, at New York, or even here, to understand fully the circumstances of the strike, and of this agreement, which is as follows :

"The present maximum wages of \$3.50 per day shall be paid to all underground men.

There shall be no discrimination in the employment of men, the men now in the country shall have the preference. No men shall be imported for the purpose of working in the mines.

The men who lately left the employment of the company, who were objected to, shall not again have employment in any of the above mines.

It is hereby agreed by both parties hereto that should any differences arise between the parties hereto that the same shall be settled by arbitration.

It is the desire of both the above parties that the long-existing differences be and are hereby buried for all time, that henceforth both parties be friends, and work for the mutual benefit of both parties."

The continuance of the \$3.50 rate is no doubt unreasonable, but has a hundred parallels in the affairs of trade that receives no comment. The importation of men, prohibited by the agreement, looks like a drastic clause, but it is a sequence of a system that has worked greivous abuse in this country, and in a manner that prevents wonder at such a demand on the part of miners. We have imperative laws preventing labor contracts for foreign workmen that are of no avail, as everyone knows, and whatever the ethics of the matter may be we are obliged to consider the impression made on the minds of workmen themselves.

Those who think that force, instead of reason and a sense of fairness, will restrain men from exorbitant demands will find themselves mistaken in the end, and if the miners at Cœur d'Alene knew or thought that a rate of \$3.50 a day, or other of their demands, would lead to loss to themselves and their employers in

the end, they are either too stupid or dishonest to be good citizens, or citizens at all. Many years ago at the Baldwin Locomotive Works, in Philadelphia, a great strike was imminent. The firm, instead of asserting the rights of owners and duties of workmen, employed a learned man to write an essay on the subjects in dispute. The men were called together, and a council was held, resulting in an arrangement that has lasted for twenty years, and will, no doubt, last for a hundred years to come. There are no strikes there among three to four thousand men, who were by thoughtful means caused to think out the true relations and rights involved in the business. The same thing can be done, as we believe, in nine cases out of ten.

Under the management of Mr. Thos. H. Leggett, the Bodie Consolidated Mining Company, at Bodie, Cal., erected in 1892 an electric power plant 12.5 miles from their mills, and by means of directly-connected Pelton water wheels, and a Westinghouse 120 kilowatt motor, generate about 160 horse power, which is conducted at a voltage of 3,000 over a No. 1 bare copper wire, passing over hills 800 feet high, crossing ravines, and terminating at the mill $12\frac{1}{2}$ miles distant. The loss of power or current on the line is only eight per cent., and the mechanical efficiency from the water wheels to the mill gearing is estimated at from 70 to 75 per cent. The cost of the plant was \$38,000, and the saving to the Company over steam power has exceeded \$2,000 a month. Wood costs at Bodie \$10 a cord. Mr. Leggett now proposes an additional plant to operate the mine hoists and pumps, and plans have been laid out for this extension. He read a paper at the February meeting of the American Institute of Mining Engineers this year, giving full particulars of the mill plant above mentioned.

If reports are correct the progress made in preparing explosives that do not cause flame, and will not ignite gas, one danger in coal mining is to be overcome. It is true that safety from ignition by the explosion of blasting charges may lead to greater carelessness in respect to lights, but this has not proved the case in the coal mines in England, where this flameless powder is in use. The cartridges are wet, or in liquid gelatinous form, and are exploded by electricity, so there is no fire in the case. The resources of chemistry must be nearly exhausted in the search for explosives, in fact the ideal conditions are nearly filled if both smoke and fire are eliminated. Dry lime is employed to some extent in England for blasting, or was some years ago. Charges of this when subject to moisture swell up and split rocks or other material in a silent deliberate way.

Some of the mines in England call for long winding ropes of large size, and the conical or spiral drums to compensate for the gravity of the ropes have attained an enormous size. One recently made, principally of steel, is 33 feet extreme diameter, and 18 feet for the smaller diameter, the convolutions being made of angular grooved bars of steel riveted on spirally. The core is composed of cast iron hubs 9 feet diameter, and a plate drum, built on these, 18 feet diameter. Beyond this begins the spiral winding path, fifteen convolutions, reaching, as said, 33 feet in diameter. The drum is for a coal mine 763 feet deep, the service load being four tons. The gearing is operated by a pair of engines 45 inches bore, 84 inches stroke, which makes up, perhaps, the heaviest winding plant in the collieries of that country.

The Cripple Creek mines, in Colorado, are reported to be producing over \$500,000 a month, and the amount has increased gradually since the great strike ended. There is also a prediction that by January first next the output will reach a million dollars per month. If so the camp can "go up ahead," and come next after Leadville and the Comstock. The business at Cripple Creek began in the usual way with placer mining, and has been developed normally as in other cases of permanent mining camps. The lodes are said to show no signs of exhaustion. The Black Hills district claims a production of \$100,000,000 during eighteen years past, one half of which came from the Homestake mines. The ore is poor, never exceeding \$10 to the ton, and frequently falling to \$2.50 per ton, but there is plenty of it. The vein is 400 feet thick, and the operating force equals 1,500 men working ten hours a day.

Makers of mining machinery here, especially those with a connection in Australia, should derive some advantage from the new field opening up in Western Australia. This is almost an unknown land, that includes nearly one third of the Australian Continent, or of Australasia, with a fringe of settlements around the coast, and an almost unexplored interior, barren, dry, and inaccessible, the only thing indicating any permanence or even fact in present reports about gold finding in West Australia, is a brisk business in mining shares of that country in London, but it is not the first time, if the whole matter turns out a myth. A good deal of capital and machinery is going there at the present time, but orders are no doubt given for all of it in Sydney, and Melbourne on this side, and any new business will appear in the general trade to Australia.

MISCELLANEOUS NOTES.

In California, as in most other States, ships are taxed like other personal property. Here, in San Francisco, a merchant who owns a ship, or any part in one, is expected to pay tax on this property the same as on buildings, goods or street-railway shares. That he does so need not be argued, but in the case of the ships one may ask, what for? Taxes are to provide courts of law, police machinery, pavements, sewers, lights and so on, but ships do not use these, at least do not use them to any extent. A vessel must furnish her own resources when at sea, and that is where she is supposed to be most of the time, besides she has to pay light dues, harbor dues, and a dozen more kinds of tax that does not apply to land property. There is a broad distinction here, and a discrimination against marine property, that accounts for a good deal of the lamentable condition into which our foreign shipping has fallen.

The Philadelphia Gas Company, which means the principal supply of natural gas at Pittsburgh, has from the first organization as a gas association made plans to generate a supply from coal if the natural source failed. This company, of which Mr. George Westinghouse is president, operates under an old charter of an omnibus kind, that was empowered to do almost anything, and naturally fell into gas supplying. They have now connections to 30,000 houses in Pittsburg and vicinity, and cannot well abandon their distributing pipes. At present it is proposed to only supplement the natural supply from the wells, but it is believed that in case these fail gas for fuel can be profitably made from coal at the mines and brought into Pittsburgh. The great beds of culm that lie all over the coal regions should be available for gas. In Ohio there is enough such fuel to supply heat over the adjacent country, or within distances that pipes can be afforded, for years to come.

It is a shame, or at least a misfortune, that no one has invented some other material than wool for carpets, or floor covering, that is, something which has the same or equal qualities with wool. It is true only coarse wools are used for all but luxurious carpets, but the

enormous consumption of stock that would at least make coarse cloth, keeps up the cost of clothing. A woven paper carpet is announced, but this form would not be much cheaper than wool or cotton fabric. The Chinese should have paper carpets, and no doubt have, and if the want had been known a few centuries ago they would, no doubt, be in the business now. Some homogeneous substance impervious to water, and cheap, is what is needed. Such floor covering is now made that has the required properties, but is as dear as woven fabrics.

Of 12,907 merchant vessels registered at Lloyds, in London, 304 have a speed exceeding 15 knots an hour, and only 45 that exceed 19 knots, all of them built since 1889. There are but 18 that exceed 20 knots, and of these 11 are paddle ships in the Channel, or inland service, leaving 7 of the deep-sea class. Two of these, the *New York* and *Paris*, belong now in the American International Line, and the *Majestic*, *Teutonic*, *Campania*, *Lucania* of the British lines. There are 27 vessels of 19 knots and over, 22 are paddle ships; 15 are British and 12 belong in other countries. Of the 18 that steam 20 knots and more, 10 are British and 8 of other countries, and of vessels exceeding fifteen knots 205 are British and 99 belong in other countries. In *Engineering*, where these statistics have been presented, it is said the fastest vessel in the United States is the *Kansas*, of the Savannah Line, which will be a matter of surprise to most people. These figures do not include lake, river or sound boats in this country, only sea-going vessels.



"INDUSTRY."

JOHN RICHARDS, EDITOR.

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No. 77

CONSTRUCTIVE ENGINEERING ON THE PACIFIC COAST.

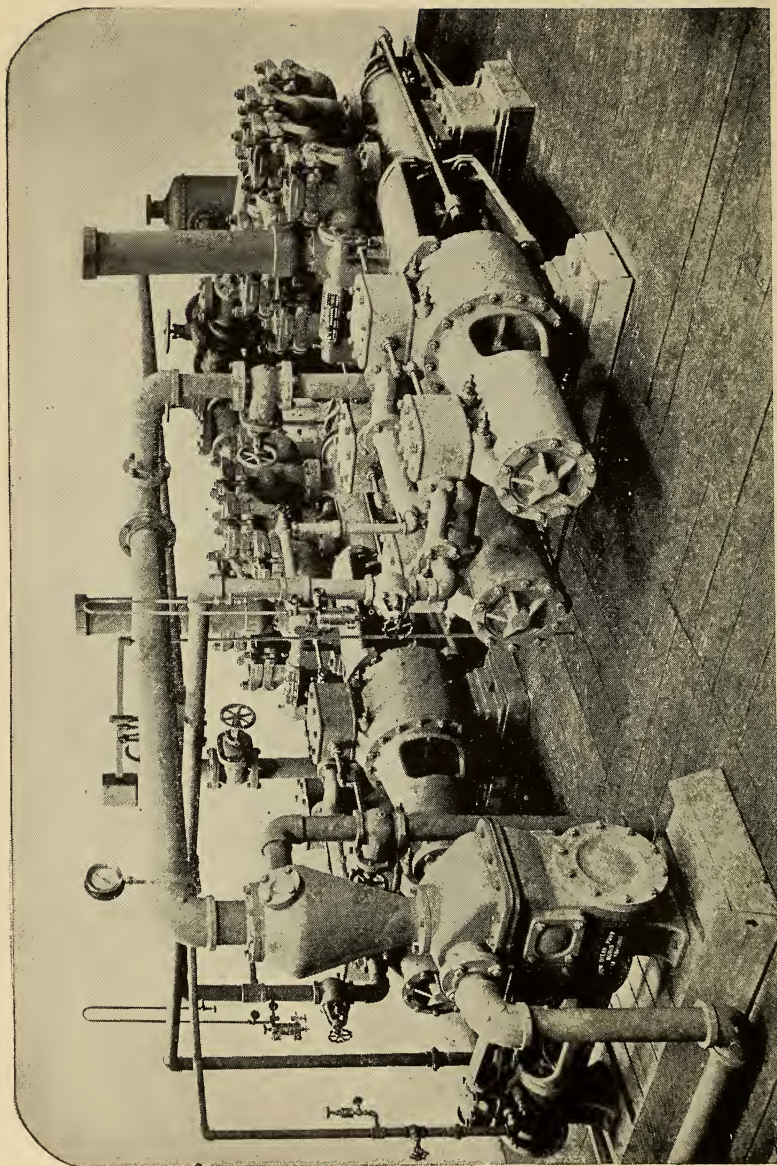
No. I.

There is in the Eastern States a wrong impression respecting the works of an engineering character on this Coast. This fact appears at once when the subject is discussed anywhere east of the Rocky Mountains. It does not relate to manipulative processes or to degrees of skill so much as to the "kind" of skill, and differences of circumstances that are not easy to explain. The present article will be an attempt in that direction.

Throughout the length and breadth of this country, what may be called machine-shop practice, methods and design, are tolerably uniform until one reaches the Pacific Coast, then there is a change; not a change that impresses one at first as improvement, but as something unusual. It is because of isolation perhaps. This is almost the only place in these later years where the division and organization of engineering work does not control almost every branch of manufacture, or of construction, we may say, because there is no "manufacture" of machinery here, in the true sense of that term.

This circumstance naturally causes an inference of primitive methods, expensive construction, and imperfect design, but this is not so, in fact quite the reverse, as we expect to show. Skill, which

B 1



BATTERY OF DIRECT-ACTING COMPOUND CONDENSING PUMPS.

DOW STEAM PUMP WORKS, SAN FRANCISCO.

Compact plant for underground working in mines.—To operate with steam or air in conjunction with sinking pumps.—Capacity of the plant as shown, 400,000 gallons an hour.—To operate against heads to 1,000 feet. Condenser and air pump in front acting for all pumps.

is the main determining factor in the cost of engineering work, has a diversity here quite competent to deal with the different kinds of work carried on. Such skill is well paid and vigorously used.

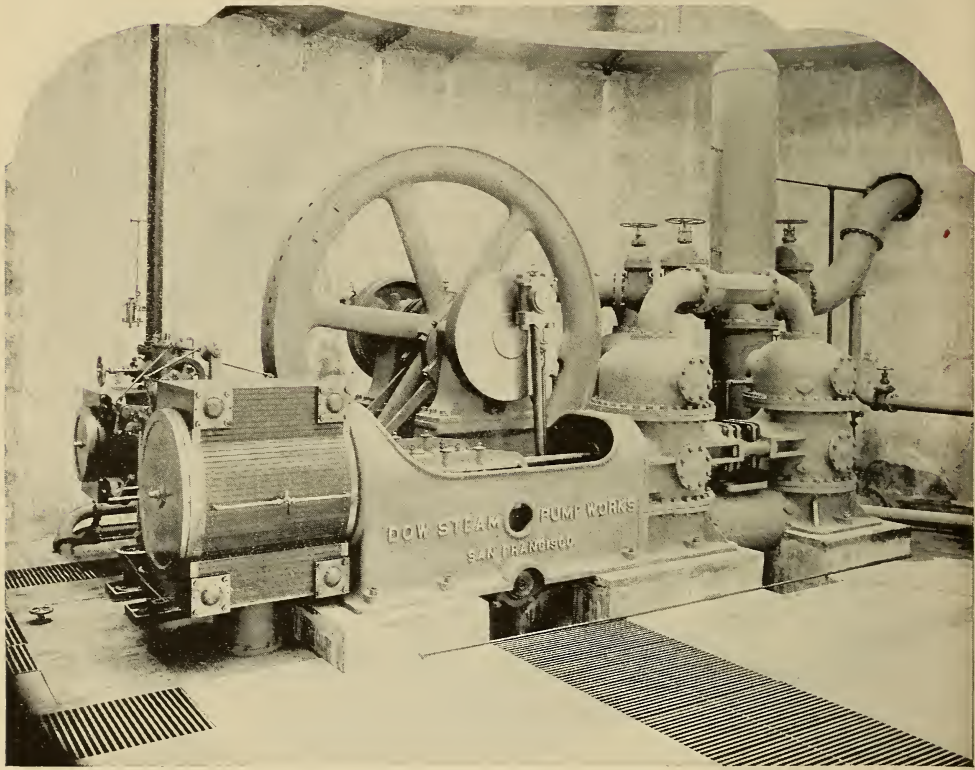
In the works at San Francisco one will find in the draughting room, and on the staff of the principal firms, people from every part of the Eastern States, and from all the skilled nations of Europe—Germans, Swedes, Swiss, French, Russians and Spaniards. Some come for their health, some because it is a stopping place on the way around the world, many because the isolation of the City is supposed to produce chances of employment not found in Eastern cities, and still more come to gain experience. These men, many of them of the highest accomplishment, bring with them whatever is known in their country, or former homes, so there is an aggregation of skill not met with in the Eastern cities of this country. To this can be added the effect of novel requirements owing to various physical circumstances of the country, its climate, geography and products.

A machine works, or an engineering establishment, which name fairly applies to all the larger works here, is supposed to contract for and construct any kind of work demanded. A traction engine, ore crusher, marine engine, and dredging machine, may be found going on together. Steam engines, mill gearing, steam boilers, plate work, hydraulic machinery, refrigerating apparatus, and saw mills, are undertaken with the same assurance, are usually well made, to embody all recent improvements, and with commonly a good many new features added.

HYDRAULIC APPARATUS.

The Pacific Coast is a country dealing especially with water. A dry season of four to six months, and intense agriculture by irrigation on the lower levels, calls for water conservation and distribution on an enormous scale. Copious precipitation in the winter over a mountainous country, near the coast, produces thousands of summer or snow-fed streams that descend thousands of feet, affording water-power at least six times as great as the same volume of water would produce on the Eastern slopes of the continent. Extensive mining and reclamation works add a great deal to the hydraulic requirements, and water apparatus is seen on all sides of every conceivable form, for high and low pressures, large and small volumes.

The methods of measurement are peculiar, and arise from the small volume dealt with, and its distribution from ditches or flumes



HIGH-DUTY PUMPING ENGINE.

THE DOW STEAM PUMP WORKS, SAN FRANCISCO.

Cross compound engines.—Corliss valve gearing.—Plunger pumps, large valve area.—Controlled by a water regulator.—All chambers cylindrical in form.—Strains are inherent as far as possible.—Main frame reduced by arrangement to its smallest dimension, and the area occupied reduced to its lowest possible limits.—Made to raise from one to ten millions of gallons a day.

to various consumers for power or irrigation. The apparatus employed is shown on page 726.

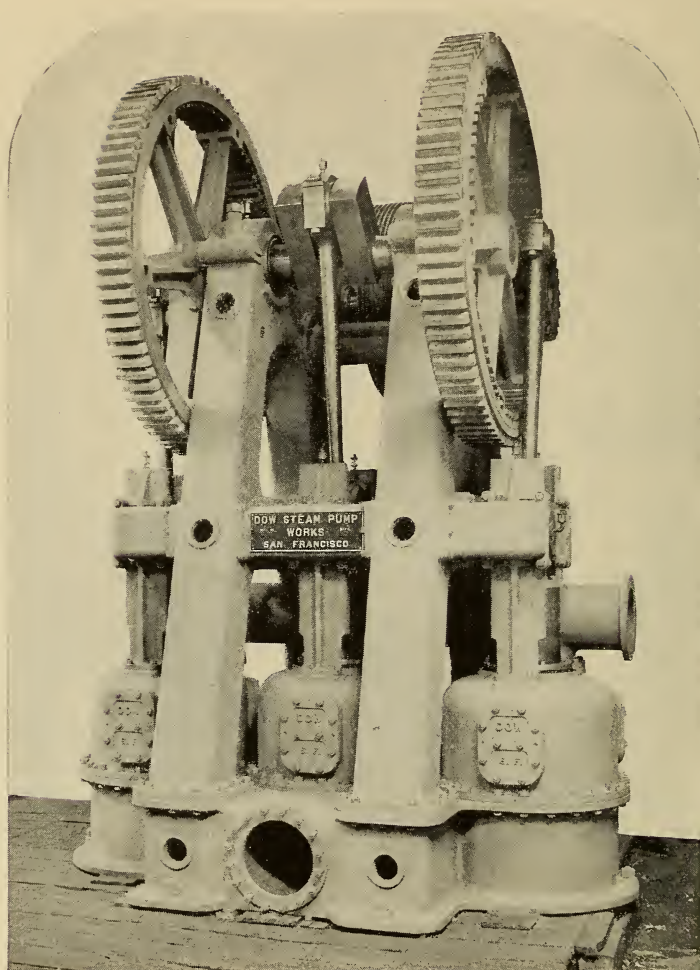
In the plates herewith, and the brief specifications below, will be seen examples of contemporary practice on this Coast, mainly of standard machinery, however, because it is not common to engrave special machines or apparatus of any kind.

In these examples, selected without reference to particular functions or results, may be seen an advanced practice, and if space permitted a good many features of novelty could be pointed out. In so far as the cost of construction, it will be a matter of wonder how machinery of the kind is made to compete with the organized manufactures in the Eastern States and abroad, but there are good and sufficient reasons for this, as will be pointed out.

Taking, as an example, the class of encased triple pumps, of which two examples are shown. When this type was introduced on the Pacific Coast it was to meet a demand for which no machinery then made was suitable. This demand was for pumps to be operated by electric motors, so arranged as to offer an uniform resistance, and, as electric current was dear, to operate with minimum friction for both machinery and water.

Such pumps were sought for all over the United States, and none were found to meet the requirements set up by the electric companies, who supplied current for operating hydraulic elevators, pumping being necessary because of the high rate charged for water by the city service. The matter was then submitted to local makers of pumping apparatus, and pumps were at once furnished conforming to the requirements, consuming not more than five per cent. in friction of both machinery and water when the pipes and fittings were of good quality, or properly designed. Without any boast in the statement, we think it safe to claim that the average service for small amounts of water given by this class of pumps in this City, is far above what is obtained elsewhere in this or any other country.

In what are called "deep-well pumps," extensively employed in the sedimentary or low districts, where the barrels are set from one to two hundred feet below the service, there is also excellent practice on the Pacific Coast, and attainment of continuous flow with single-acting pumps, or those with one set of valves, that seems to be but little known or considered elsewhere. The conditions that permit or cause a continuous flow with long columns of water are, if mathematically considered, quite complex, and, so far as we know, is not a characteristic of practice elsewhere, but is here recognized



GEARED TRIPLE PUMP.

THE DOW STEAM PUMP WORKS, SAN FRANCISCO.

Gives a constant flow and uniform resistance.—Water chambers all cylindrical or spherical.—External guides, and water-sealed glands.—Occupies a minimum of space and foundations for support.—Crank shaft driven at both ends.

and provided for in the length and size of delivery pipes, piston speed and avoidance of angles. Deep-well outfits throughout, and including every detail, are about fifty per cent. heavier than is common elsewhere, and are durable in proportion.

To these circumstances, which enables competition here in the construction of water-raising apparatus, can be added the difficulty of makers elsewhere adapting their machinery to the high heads and pressures to be dealt with here, and, at the same time, to the general market elsewhere. An organized manufacture does not permit this; cast-iron sections must be heavy, valves must be thicker and stronger, seats must be securely fastened, and all gearing, such as shafts, cranks and connections, even for average service, must far exceed the requirements in the general market of the Eastern States.

Another circumstance in favor of the makers of pumping apparatus here is the short time in which large plants can be prepared and erected. The versatility of the works, to so call it, permits a large force from all departments to be at once set at work upon a new job.

The large pumping plant, to deliver seven and a half millions of gallons a day against a pressure of eighty-six pounds to an inch, to supply the fountains at the Midwinter Fair was made and erected in twenty-six working days' time.*

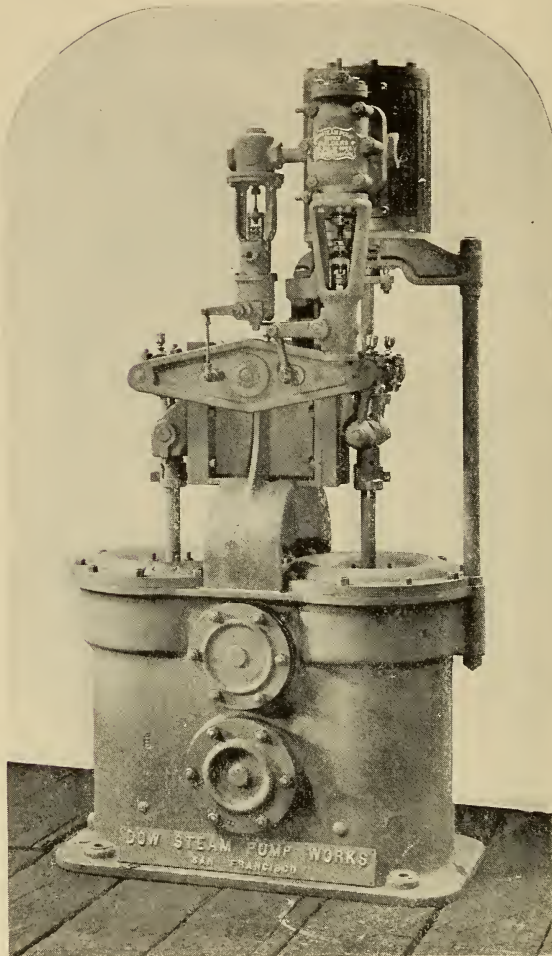
The machinery for a large stamp mill, with all of its multifarious details, is sometimes completed in twenty days, and sent away.

High speed of piston pumps, a subject far from being generally considered in the Eastern States or abroad, is, no doubt, in advance on this Coast, if a number of examples are taken, and present indications are that a continuous flow with such pumps may, in the near future, exceed even the Riedler system for low heads and large volumes.

Pattern making, and the art of "doing without patterns," both excel on the Pacific Coast. Foundry expedients far exceed anything that can be seen in the Eastern States. We do not mean for organized or standard work, but to meet emergencies, and for special castings.

In various works in England the cost of producing special castings is carried out in many surprising ways, and similar expedients can be seen here in San Francisco. Almost any pattern maker can prepare a first class pattern, or "model," to use the correct name,

* This plant is illustrated and described in *INDUSTRY*, No. 74, for Sept., 1894.



DIRECT-ACTING DOUBLE AIR PUMPS.

DOW STEAM PUMP WORKS, SAN FRANCISCO.

The above is one modification out of a number made at the works.—Speed at absolute control.—Reciprocating parts light, and resistance elastic.—No dead centers, or limit of speed.—Engine is controlled by a sensitive governor, seen on the left.

because a pattern relates to but one plane, but it requires a skillful pattern maker to produce a good casting from a cheap pattern. So, in a foundry, almost any moulder with a good pattern and flasks can produce a good casting, but it takes a highly-skilled workman to "dig out" a mould with nothing more than a skeleton and a drawing for indication. Some years ago when the Navy Department sent out inquiries in respect to foundry equipment in various parts of the country, they were amazed to find the most extensive and complete for general work was on this Coast.

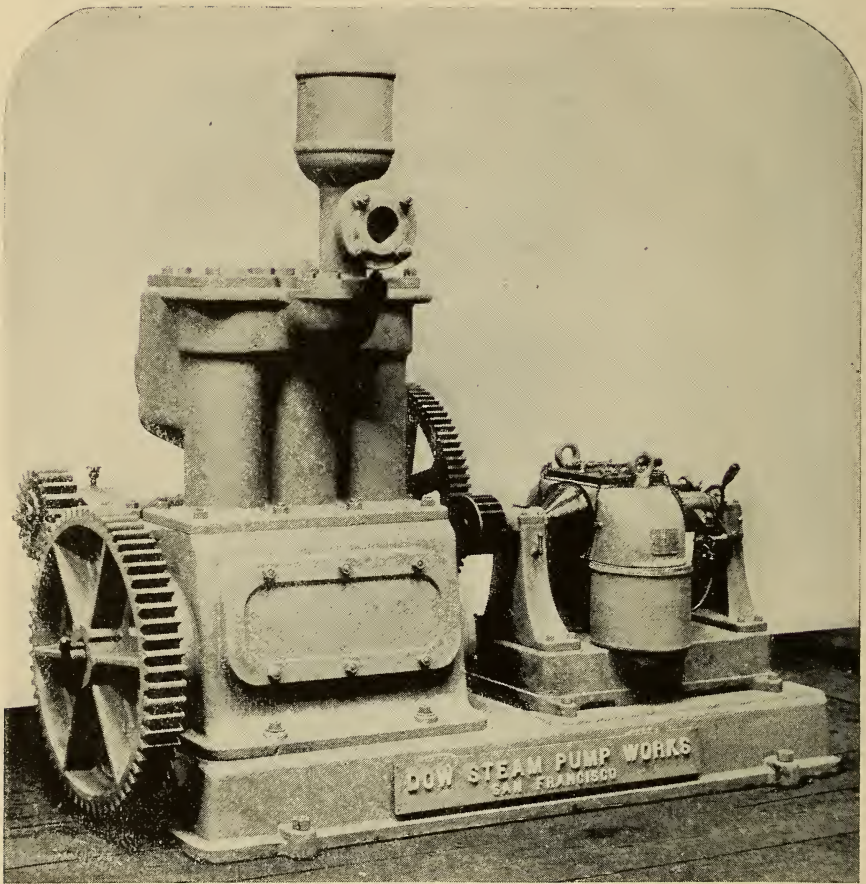
There is a common saying here that the local works can, in any line, beat all competition for original or special work, and on all things up to where a division of labor and duplication comes in, or, to state as once heard, "We can compete on one instead of ten, or on ten instead of a hundred."

Centrifugal pumping having recently occupied a large amount of space in INDUSTRY, it will not be necessary to go again over the ground. In these articles it was claimed that this method of pumping, in so far as modification and development, was in advance on the Pacific Coast. Such a claim is easy to maintain, and is proved by numerous examples that have no parallel in other places.

WATER POWER.

In respect to water power, the pages of INDUSTRY for seven years past have furnished a tolerably constant record of progress in this direction. The practice has been bold, even to audacity, and successful in nearly all cases. Both water engines and water wheels have been constructed to operate under heads exceeding 2,000 feet, and pressures of 900 pounds to an inch.

The almost constant failure for more than a century of constructing successful direct hydraulic engines to operate mine pumps did not deter engineers from bold attempts on this system. Except one or two examples in Hungary, there were no precedents for such an undertaking, but this did not prevent the construction here in 1880 of a vast pumping plant impelled by hydraulic engines under a head of 2,000 feet. The work was constructed under a rigid guarantee of successful performance, and cost \$250,000. This was soon followed by another plant of the kind of less capacity on the differential system, the engines having a variable stroke in proportion to resistance. It would have been useless to have submitted such work for tenders under guarantee in any other part of this



ENCASED TRIPLE PUMP AND ELECTRIC MOTOR.

DOW STEAM PUMP WORKS, SAN FRANCISCO.

Pump wholly enclosed.—Three vertical single-acting pistons.—Constant flow, and uniform resistance to the motor.—Made of various sizes, and for heads to 1,000 feet.

country, perhaps in any country, but it was undertaken here, and successfully carried out.

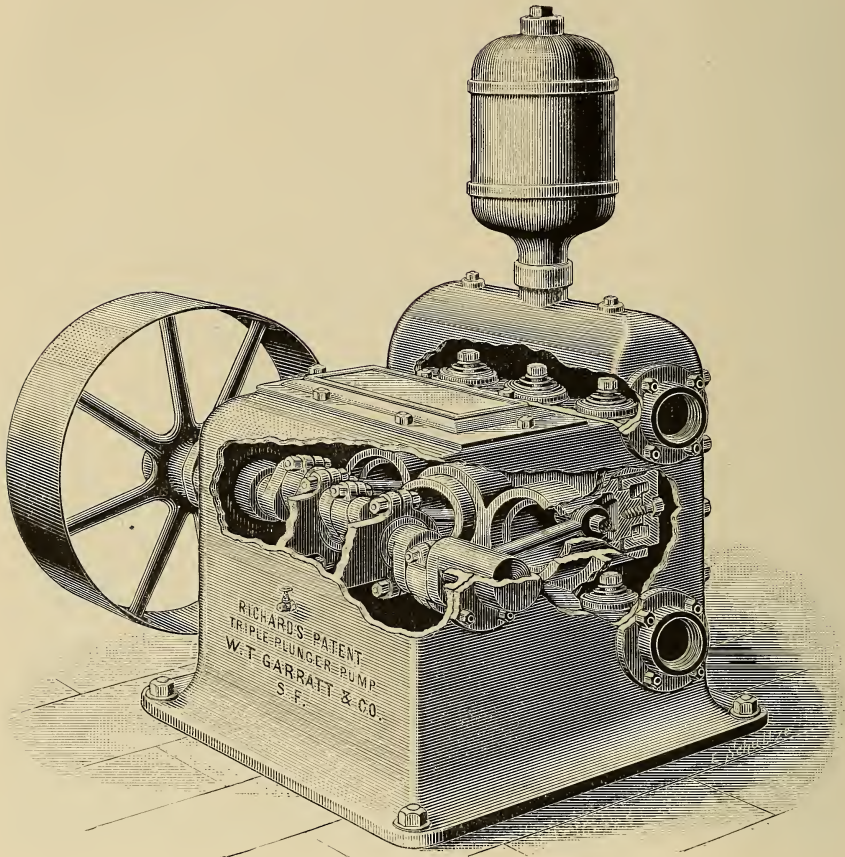
This is not all, however. Direct hydraulic engines continue to be made, and can be contracted to operate under any head or pressure, under complete assurance of successful performance. Many mines are supplied with such engines, made by Messrs. Knight & Co., of Sutter Creek, in California, who, we believe, have in this line of hydraulic practice, attained results unknown and unsuspected in other parts of the world.

One of these engines of the horizontal type is shown on page 728. They are composed wholly of forged and cast steel. The cylinders are forged or made from rolled steel, and the valve functions, the main part, are a study in their peculiar operation. The momentum of the vast columns of water in the uptake pipes, and also in the supply pipes, is cushioned by the eduction valves, and the action is noiseless, without jar or concussion. It is an impressive sight to see one of these silent engines at work under pressures that would operate punches, cranes and the like.

In the field of rotary hydraulic apparatus the development of a new type of tangential or impulse water wheels forms another remarkable fact in the engineering practice of this Coast. This subject will be treated in our next paper.

(To be continued.)

The editor of the *Engineer*, London, in a recent article on governing or regulating steam engines, mentions a governor called "Pitchers," that it is thought will come nearest good regulation for electric-light engines. This governor consists of an air pump operated by the engine discharging into a cylinder that has an adjustable escapeway, and a piston connected to the engine throttle valve, so the slightest change in the speed of the pump or compressor causes this piston to move accordingly. It is suggested that water or oil would be better than air, and this is proved by an application here in San Francisco by Mr. Geo. E. Dow for pump regulation. It is hard to see why such a governor would not be much more efficient than a centrifugal one to regulate the speed of common steam engines. It has a precedent, and a good one, more than a century old, in the "cataract" for controlling Cornish pumping engines, and if worked out for common use will, no doubt, be more sensitive and reliable than present methods.

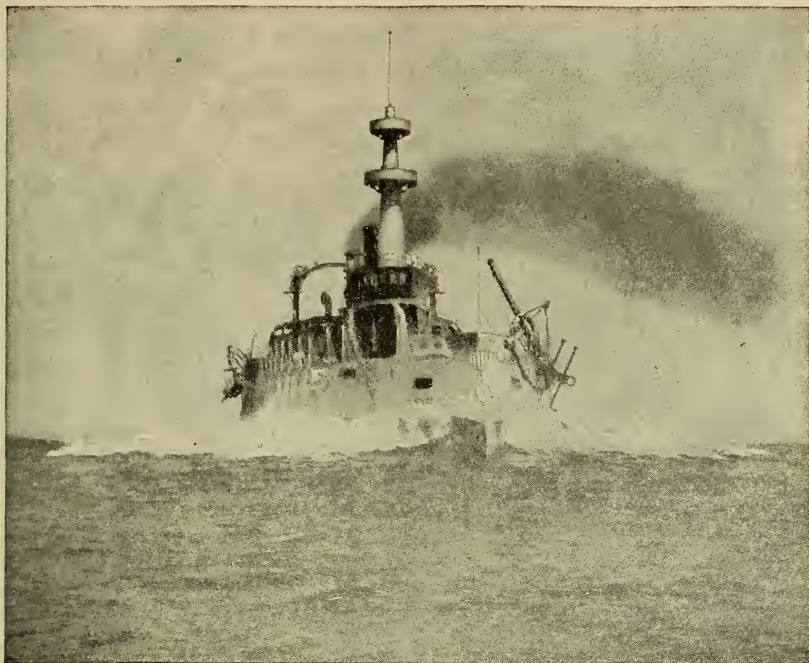


Constructive Engineering on the Pacific Coast.

ENCASED TRIPLE PUMP.

W. T. GARRATT & CO., SAN FRANCISCO.

Pistons are horizontal.—Gives a constant flow, and offers uniform resistance to a motor.—Crank shaft and outer ends of pistons flooded with oil. Water passages direct with but little change of course.—Frictional resistance of machinery and water reduced to a minimum.



A PRELIMINARY TRIAL OF THE "OREGON."

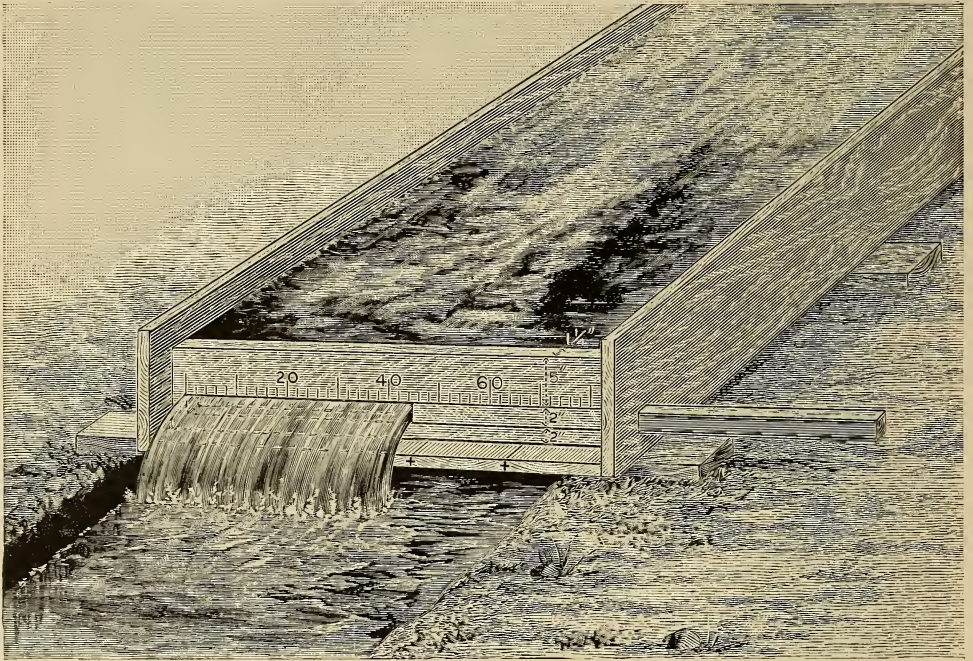
PRELIMINARY OR DOCK TRIALS OF A BATTLE-SHIP.

The following graphic account of the first trials of the *Oregon*, by Mr. G. W. Dickie, is reprinted from *Machinery*, of November, 1894.

* * * The whole water front of San Francisco consists of a "mud-bed" of great depth and very soft, the necessary depth of water being maintained by constant dredging. Consequently the depth of water at all the wharves, is just sufficient to enable vessels to be moved, and at most of the wharves a large loaded vessel is usually resting on the bottom at low water.

Owing to this silt being so close to the sea valves, through which the circulating water for the condensers and water service for the bearings has to be taken, it was found impossible to make dock trials at the works, without a risk of having journals ruined if water was applied to them, or the condensers and pipes choked.

This was at first considered a great disadvantage, but like most natural obstacles, the necessity of the case resulted in a better method of conducting such trials. In front of the Union Iron



Constructive Engineering on the Pacific Coast.

WATER MEASUREMENT BY MINER'S INCHES.

PELTON WATER WHEEL CO, SAN FRANCISCO.

The miner's inch is from 1.36 to 1.73 cubic feet per minute, varying in different places in respect to the head above the slot. This head is commonly 6 inches from the center of the slot, and the slot 2 inches above the bottom, as indicated by figures on the drawing. This system dispenses with "time" as an element in measuring water.

Works, about a half a mile from the docks, very substantial moorings have been laid, with a large steel buoy, to which the vessel is secured by simply passing a large manila hawser through the ring in the buoy, both ends being secured to the riding bitts on the fore deck of the vessel, so that when one end is let go, the vessel is free. There is about fifty feet of water at low tide at these moorings, so that all pumps can be operated in clear water.

For some time past, the *Oregon* had been waiting for her belt, barbette and turret armor, and in consequence was ordered docked, to have her bottom cleaned and painted. This required her to be moved from a berth she had occupied, and it was decided to make her preliminary trials before she returned. Sufficient coal was placed in the bunkers before leaving the works for these trials, it being the rule to use the same kind of coal as will be used on the official trial, so that experience is gained in its use.

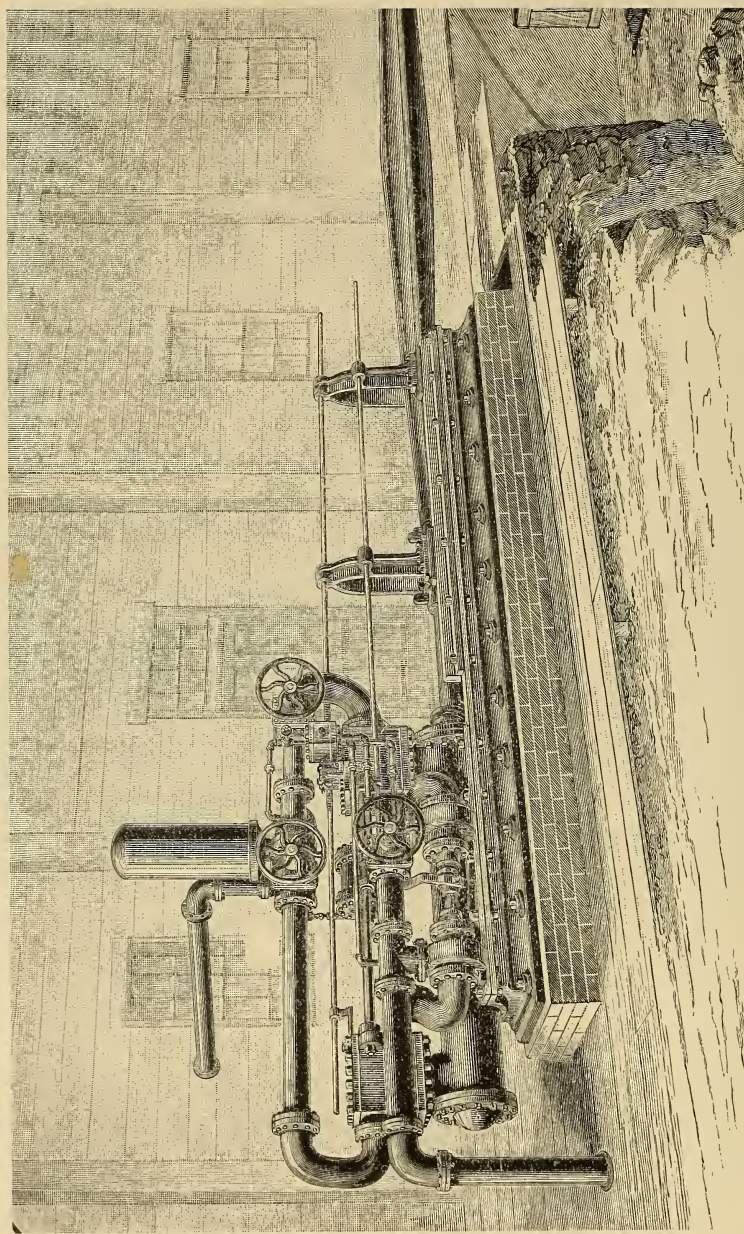
On Monday, the 13th of August, the *Oregon* was at the moorings, and the testing of steam-pipes, etc., required by the engineer inspector, was completed that night, enabling steam to be raised in all boilers on Tuesday. The air and circulating pumps of the auxiliary condenser, of which there is a set in each engine-room, were the first to go into service, so that the steam used in trying the numerous auxiliaries might be condensed and returned to the boilers. One of the dynamo engines had been running for a week exhausting into the atmosphere. This was now turned into the auxiliary exhaust system.

Next the main circulating pumps were started, sending the water through the main condensers, this important function being successfully brought into operation. The air pumps being independent in this case, next receive attention, also the light service pumps that take the water discharged from the air pumps, and deliver it to the feed tanks, which are placed between the two sets of main boilers.

Having all these operating satisfactorily, the main and auxiliary feed pumps come next. These are placed close to the main feed tanks in the fire rooms, forward and aft of them, being all ready to respond to any demand that might be made upon them. Next there are eight fireroom blowers, one in each fireroom, operated by high speed compound engines of a special design, adopted for this purpose by the Union Iron Works, which respond very readily, having all been tested under steam at full speed in the shop, before being placed on board.

It was then late on Tuesday evening, and having seen the hydraulic pumps for the steering gear, and the gear itself all in motion, it was safe to say that to-morrow (Wednesday) would see the main engines move.

Accordingly, prompt at 9 o'clock A. M. the Works' tug left the dock, and placed on board the *Oregon* the Government engineer and naval architect, who were to look on and report to the Navy Department, the president and manager of the works, with some friends of the company.



Constructive Engineering on the Pacific Coast.

DIRECT HYDRAULIC PUMPING ENGINE.

KNIGHT & CO., SUTTER CREEK, CALIFORNIA.

Engine wholly of steel and wrought iron.—Stroke cushioned by education valves.—Engines noiseless, and without jar.—Have been in use for six or more years past in a number of mines.—The connection on the right extends to the pump rods.

Soon the main engine's auxiliaries were in motion, and the chief engineer of the works moves the reversing lever of the starboard engine. The links are moved from ahead to astern perhaps a score of times, with just a breath of steam admitted to warm the cylinders. Then a little more steam and the cranks begin to move a little, first one way, then the other, as the links move into ahead or astern gear. Now a little more steam, and as the links move into ahead gear, the first revolution is accomplished, a few more turns and the links are moved to go astern. The response is prompt, and the little party moves to the port engine-room, where the same programme is carried out with equal success.

The Captain is now notified that orders can be received and carried out in the engine-rooms from the pilot-house. He orders the first officer to let go, one end of the hawser is quickly released. The steam winch pulls it through the ring on the buoy. "Go ahead slow," is telegraphed to each engine-room, and the battle-ship *Oregon*, whose engines had made their first revolution only five minutes before, is under way, and moving out amongst the shipping to a clear space in San Francisco Bay, which is well adapted for such preliminary trials. A straight course of twelve and one-half knots can be run between Hunter's Point on the south, and Red Rock on the north. And the *Oregon* is now headed for the south end of this run, about two and one-half knots south of the Iron Works.

Gradually the big ship gathers headway, more steam is given the main engines, until both sets are making 66 revolutions per minute, giving about nine and a half knots speed to the vessel. According to the trial programme this is to be the speed for the first day. Everything proceeds very orderly in the engine-rooms, a strict watch being kept on all moving parts, the only disturbing element being the air pumps, which are of the geared type, and although they are doing their work very effectively, they are like some people who do good work, but make too much noise about it.

After three hours' run at 66 revolutions, during which careful notes were made of how everything worked, the engines were speeded up to 82 revolutions for about one hour, coils being taken, and the working carefully noted, after which the trial for the first day ended, and the vessel returned to her moorings. From the information obtained on the first day, certain little adjustments were thought necessary in the valves of the air pump engines, and on that account no run was made on Thursday.

Promptly at 10 o'clock on Friday morning, the *Oregon* was again under way. The first movements of the main engines are not watched with the same interest this morning, as they had run for hours on Wednesday at 66 revolutions, and for a little while at 82 revolutions; so this day they were soon speeded up to 80 revolutions, and kept at that speed for four hours, every moving part being carefully attended to, the speed of the ship being eleven knots; horse power, 2,690. For an hour at the close of this day's run, the engines

are allowed to run at 100 revolutions, the ship making thirteen and one-half knots, the horse power being 4,064, and being fully up to the programme was accepted as very satisfactory, and expectations for the next day were very high,

On Saturday morning, the inspectors and Work's officials were all on board in good time, and the start was made promptly at 10 o'clock. Within a few minutes of the start the engines had reached the revolutions of the day before, and for three hours the engines were kept at a steady speed of 105 revolutions, the ship making a little over fourteen knots. As no sign of trouble had yet appeared, the confidence of every man on board seemed to rise with the speed of the ship. The fire-room blowers were speeded up a little, the fire-rooms being still kept open; and as the steam went up, the throttle was opened a little further, and the last hour of Saturday's run was at 120 revolutions, the horse power being 8,160, and the speed sixteen and one-quarter knots.

The trial having gone beyond the programme for the first three days, it was decided to remain at the buoy until Tuesday morning, the time being occupied in a close inspection of all parts of the machinery, this being considered necessary, no matter how successful the trials had proceeded thus far. Nothing having been discovered to change the programme, Tuesday morning, the 21st, found the vessel ready for a further test.

Again at 10 o'clock the *Oregon* left her moorings, and in less than half an hour the throttle was wide open, the engines making 126 revolutions, developing 9,500 horse power, which speed was maintained for six hours, without a hitch of any kind, the speed of the ship being about seventeen and one-half knots.

Thus, in four runs of about six hours each, this splendid set of machinery was worked up from the first movement to its full capacity, without having to stop at any time for any cause, from first to last, carrying out a programme of increasing the speed of the engines by 20 revolutions each day. Much of this success is the result of going at once to clean deep water, and with the ship free. Not only are the engines tested by this method under normal conditions, such as prevail on official trials, but the steering gear, deck engines, and in fact everything, is tested together. It combines the dock with the contractor's sea trials, and saves cost. The present indications are that the success of the United States battle-ships, will be as marked as that of her cruisers.

WEIGHT OF MARINE BOILERS.

A year ago, and on several previous occasions, we commented on the conservative practice of Commodore Melville, chief of the Bureau of Steam Engineering, in keeping up the weight and dimensions of

boilers and engines for the United States Navy. In a struggle to reduce such weight in proportion to horse power there has been the usual result in all such cases of trenching on extremes. In his report for the present year Commodore Melville says of this matter :

"In all its designs for machinery, whether for a tug, a battleship, or a cruiser, the Bureau has, in spite of much adverse criticism, insisted on a fair proportion of weight for power, especially in the boilers, as a consequence the Department has been spared the annoyance of failure on trial trips, and, without exception, all machinery built from its designs has done all, and more than all, that was required of it on the first trial, and without distress, accident or injury of any kind. Such a record is unique, and, when the high powers and unprecedented speeds of some of the vessels are considered, it is one to be justly proud of."

D.V.R.

CALIFORNIA CRUDE OIL AND ITS USE AS FUEL.*

By A. M. HUNT, Mem. Tech. Soc.

Crude petroleum has established its position as a reliable fuel for power and other uses, and the advisability of its use in a plant is only a question of price, except in cases where convenience, or some special feature or condition, makes it preferable to coal at a lower equivalent price, or certain other conditions preclude its use.

A brief statement of the present output of petroleum in California is first given. The present production of crude oil in this State will aggregate 50,000 barrels monthly, the principal producers being the Pacific Coast Oil Company, the Puente Oil Company, and the Union Oil Company, of California.

The output could doubtless be materially increased. The qualities of the productions of the different fields vary greatly, the oils ranging from very light to very heavy. The lighter oils are extensively used for producing gas. The Puente oil, which is sold principally in Los Angeles for fuel, has a specific gravity of about 32 degrees Beaume.

About 60 per cent. of the production of the Union Oil Company will average 26 degrees Beaume, the remaining 40 per cent. being 23 degrees. So far oil has been found in quantity only in the southern part of the State, and as none of the producers have any

*Read before the Technical Society of the Pacific Coast, Oct. 5, 1894. Reprinted by permission of the Executive Committee and the Author.

other facilities than tank cars for getting the oil to this market, the price has been such as to give coal the advantage.

The Union Oil Company has about decided to build a tank barge to carry oil in bulk from their wharf at San Buenaventura to San Francisco, and the reduction in transportation charges will be such as to enable oil to compete successfully with coal.

Oil is being brought to this market from Peru by tank steamer, but as I have had no experience with it, and have no data concerning it, I shall confine my remarks to the California product.

There are three distinct methods of burning fuel oil :

First.—By hearth fires, where the oil is burned in open pans or plates, or it drops from small pipes, and spreads over the bottom of the furnace, or the bottom of the furnace is covered with some porous, non-combustible substance, this material being saturated with oil which is fed from a tank by gravity. This method is, or should be, entirely obsolete.

Second.—Covers all those devices where the fuel comes into the furnace as a gas, being vaporized in a supply pipe. It has also fallen into disuse.

Third.—By spray burners, which inject the oil into the furnace in a spray, or in fine jets, by means of steam or air. A vast number of such burners have been devised, the advocates of each claiming it to be the only perfect one.

As an example of an oil-burning installation, a description of the plant in use at the Midwinter Fair is given.

The specifications of the Pacific Insurance Union require the storage tanks to be placed underground, and that they be provided with vent pipes for the escape of gas, these vent pipes to have the ends covered with copper wire gauze.

At the Fair there were two tanks of about 6,000 gallons capacity each placed in the same hole, the sides of which were cribbed. A high fence was built around the place, and a locked gate kept out the curious. Each tank had a suction pipe, a vent pipe, a smother pipe and a return overflow pipe. The suction pipes were carried to within about ten inches of the bottom. At the foot of each suction pipe a check valve was placed to keep the pipe primed.

It was expected that water and sediment might accumulate in the tanks, and for this reason the suction pipes did not reach to the bottom, but on emptying the tanks at the end of six months' use neither sediment nor water was found. The smother pipes were connected with the steam system in the boiler room. They were intended for use in case of fire.

The oil was furnished in tank cars, and run into the storage tanks by gravity through a short section of hose, and a permanent pipe carried underground to the tanks from a point alongside the track. Floats, with rods passing up through the vent pipes, gave the level of the oil in the tanks.

The suction pipes, three inches in diameter, were connected to each of the two Dow pumps, No. B, light-service pattern. These pumps were fitted with hard fibre valves. The discharge was into the bottom of a small feeding reservoir, made of a five-foot length of twelve-inch wrought iron pipe capped at both ends, and fitted with a glass gauge.

The discharge pipe led from the bottom of this feeding reservoir, and, branching into two parts, ran along in front of the boilers in a cement-lined trough, which was covered with iron plates. From the top of the reservoir a small pipe led to a Dow pressure-regulating valve, controlling the admission of steam to the pump, and thus maintaining a constant pressure on the oil line.

A spring-loaded overflow valve, on a branch from the discharge pipe, was set a few pounds heavier than the normal pressure with discharge back to the tank. A small safety valve was placed on top, but was by no means a necessary adjunct. The only attention required by this part of the system was to see that the level of the oil in the reservoir did not fluctuate too greatly.

A small sniffer valve in the suction pipe enabled air to be gradually fed in, and a bleeder was fitted at the top to draw off air if the level of the oil fell too low. A very small amount of attention was required to effect this regulation.

The pressure carried on the oil line was eleven pounds, and the action of the regulator in keeping this pressure constant is worthy of record. One pump ran continuously for over three months and a half without being stopped, and supplying oil for a load varying from 30 to 2,500 horse power, and at no time would the pressure on the line vary one pound from that for which it was set.

The boiler plant consisted of eight 375 horse power Heine safety boilers arranged in two batteries of four each. The location of the burners, and arrangement of air supply, is shown on plate 1, a section through one of the burners being shown on plate 2. Each boiler was furnished with eight burners.

As will be noticed, the burners were set to discharge on a line just above the hollow tile forming the bottom of the furnace. At first target tiles were set up, as shown in dotted lines, for the flames to

Plate I.
 FURNACE ARRANGEMENT
 OF
 HEINE BOILER FOR BURNING
 PETROLEUM.
 CALIFORNIA MIDWINTER
 EXPOSITION.
 1894.

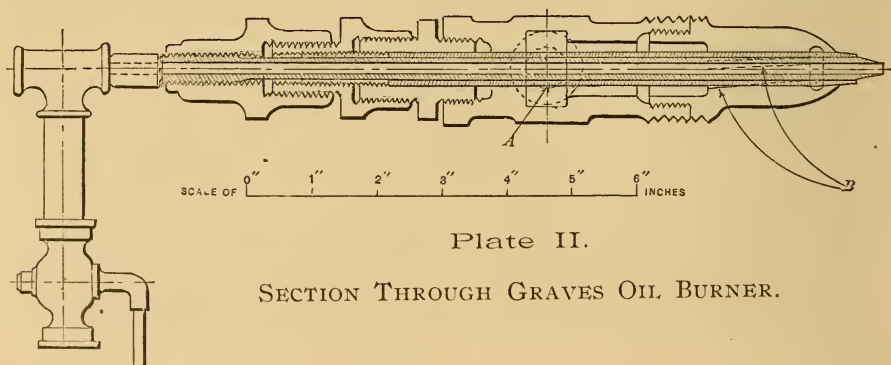
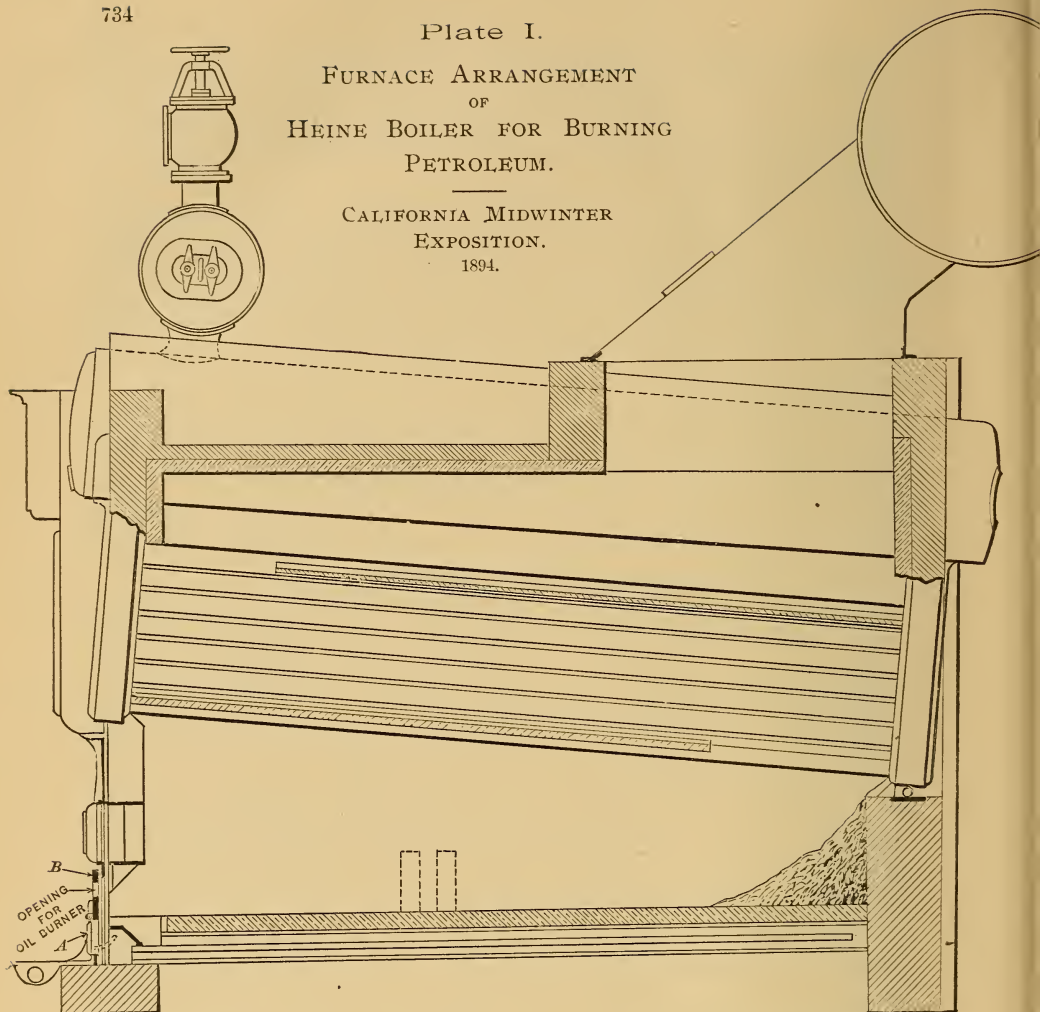


Plate II.
 SECTION THROUGH GRAVES OIL BURNER.

strike against. This deflected the flame against the tubes, and, fearing trouble with blistered tubes, the tiles were knocked down, and left as a low heap of broken rubble. After so doing the flame would strike the face of the rubble and roll over it. Any particles of oil unconsumed at this point would fall on the broken material. The back of the furnace was cut off as shown.

The air for combustion passed back through hollow tile, in this case ordinary architectural tile, then to the front, and passed up directly in front of the burners. In this way the air was, to a certain extent, heated before mixing with the sprayed oil. The door *A* swung outward on a top hinge to regulate the admission of air.

The burners were screwed into the plates *B*, placed just under the furnace doors. The openings of these doors were closed with loosely-laid bricks, one of which could be removed for examination of the interior of the furnace. There was a peep hole in each burner plate.

"Graves" burners, manufactured in St. Louis, were used. This burner, as will be seen by reference to plate 2, consisted of a central tube about one eighth of an inch diameter, through which the oil passed, its flow being regulated by the stop cock. The steam coming in at the opening *A* passed out at the tip in a cylindrical sheath, enclosing the jet of oil, catching and spraying it into the furnace. The cone-shaped tip of the inside tube formed a valve for regulating the outflow of steam, and spiral grooves *B* gave it a rotary motion as it issued.

The construction is such that the oil tube can be made to discharge at the same point as the steam, or as much as an inch in advance of it. This adjustment is of value in focusing the flame, or spreading it, as may be desired. The oil issuing in a solid jet is a disadvantage in this as in any other burner, as it gives the steam more work to do in atomizing the oil. The author has had a burner made similar to this one, but with the oil issuing in a hollow sheath, with a jet of air inside the sheath, and a surrounding envelope of steam as in this one. It should prove equally as capable of adjustment as the one under consideration and use less steam. Branches from the oil main were connected to each burner, the steam being supplied from a special header-line carried along the front of the battery.

The conditions governing the combustion of the oil should be kept carefully in mind in installing and operating an oil plant. Thorough breaking up and atomizing of the oil is essential to its

complete combustion. That burner is best which accomplishes this result with the least amount of steam or air, and at the same time is not liable to derangement, and can be easily cleaned out if it becomes stopped.

A number of small burners is better than one or two large ones. The oil can be better atomized with small burners, the flame is better distributed, and when the boiler is doing a small amount of work better service can be had from one or more of the small burners operating at their normal capacity than from a large burner cramped down. Using a number of small burners, if one becomes deranged the others can be made to carry the full load until the disabled one can be replaced.

It is very desirable to have the air for combustion preheated, not only on account of the economy, but to prevent the deposit of hard asphaltum, which is apt to take place in front of and below the burner tip. In some cases the oil is heated before entering the burner by running the supply pipe around the furnace, or by connecting a pipe to the burner, the open end of which passes into the furnace. The injector action of the burner entrains a certain amount of the hot gases. The supposed result of both of these plans is to render the oil fluid, so that it will spray more easily.

A certain amount of eye training is necessary to judge whether or not the oil is being burned so as to give the maximum heating effect. With proper manipulation of the burner, it being of proper design, and a careful regulation of the air, an almost flameless combustion can be obtained. The furnace should never be filled with an opaque, luminous flame, although many so-called practical oil men claim that such a combustion will give the best results as regards evaporation.

The best results at the Fair were always obtained by so manipulating the burner, with the air full on, as to get a blue, Bunsen-burner-like flame, and then shutting off steam and air until a tinge of luminosity began to show, chasing through the furnace in waves. Under such conditions the carbon in the oil is being entirely consumed, and the air supply is being limited just to the point necessary for its consumption. Luminosity indicates the presence of unconsumed carbon, and consequent failure to obtain the full heating effect. After the furnace once becomes thoroughly heated there should be absolutely no evidence of smoke issuing from the chimney.

The flame must not be allowed to impinge directly against the iron of a boiler. Overheating of the metal is apt to be the result.

If a solid particle or drop of the oil strikes the comparatively cold metal the volatile matter is driven off and a carbon deposit left, which, becoming incandescent, and being in direct contact with the iron, burns it.

At the Midwinter Fair there was a chance to determine the efficiency of oil as fuel, and the results of several of the tests conducted by Mr. E. C. Meier, assistant in charge of the boiler plant, and the author, are appended. In these tests both the feed water and the oil were measured by Worthington meters, and while meter tests are always regarded with great suspicion by engineers, these tests were so conducted as to be quite reliable.

Before any tests were made the feed-water meter was thoroughly calibrated by weighing the water passed through it. At first it was found impossible to get concordant results from different sets of weighings, especially when the temperature of the feed water was high. A pressure gauge was finally placed on the boiler side of the meter, and the discharge valve passing water into the weighing barrels, set so as to maintain on the meter the ordinary boiler pressure, and the pump run at a speed which furnished feed water at the rate required for the boilers under test. It was found, after so doing, that the results of different sets of calibrations did not vary more than two tenths of a pound per cubic foot registered. This was as close as the limit of accuracy of the scales.

The oil meter was calibrated in the same manner. This meter was provided with small vents to enable any gas which might collect at the top of meter chambers to be removed. Great care was taken to avoid any chance for errors. The blow lines were blanked, and feed valves so arranged that no feed water could pass into boilers not in use.

The thermometers and steam gauges used were corrected by standards. The only tests for dryness of the steam were made with an ordinary barrel calorimeter, such as Thurston describes, and the results showed the steam to be practically dry.

The average result of all the tests made was 14.2 pounds of water evaporated from and at 212 degrees Fahrenheit per pound of oil, and the highest evaporation of any test is that given in Table A, of 15.13 pounds to one.

It is a very common thing to hear oil men say that they have obtained an evaporation of 17 and even 18 pounds of water per pound of oil, and you will find recorded the results of tests showing such evaporations, attested by all the details of columns of figures

and calculations. There is suspicion that the oil used in such tests must have been thinned down with liquified hydrogen, or that the experimenter deceived himself, willfully or otherwise.

The theoretical evaporation of oil is about 20.7 pounds to one. An evaporation of 18 to one would indicate a boiler efficiency of about 87 per cent., and assuming a furnace temperature of 2,400 degrees Fahrenheit, the temperature of the issuing gases would be 312 degrees. If the temperature of the issuing gases was 450 degrees, as would be more probable, the furnace temperature would be 3,461 degrees, rather too high for comfort.

During the tests at the Fair there was no pyrometer for measuring the temperature of the issuing gases, but the strips of sheet lead suspended in the passage through which the gases issued from the boilers showed no evidences of melting.

The test shown in Table A was made on the evening of May 26, 1894. The boilers were all under full load when the test started, with burners adjusted. The height of water was marked on the glasses, and was maintained at that height during the test. At the close of the test care was taken to have water exactly on the marks. During the test no alteration or change in the burners was permitted. Readings were taken every fifteen minutes by two observers, and results compared to check errors.

Table B records the results of a full 24-hours' run, and shows all the oil burned and the water fed to the boilers. Precautions were taken, as above stated, to avoid chances for error. The level of the water in all the boilers was carefully marked, and as carefully noted when they were cut out.

The variations in load were as follows: Commencing at 7 A. M., June 21st, the load until 10 A. M. consisted only of the condensation of the pipes, and the slow running of one of the fire pumps. One burner was kept burning low in each of the two boilers, with only one boiler cut into the header. It was the usual practice to keep one boiler, in addition to the ones in use, with about half pressure of steam, so that it could be cut in on short notice.

At 10 A. M. a practically full load was thrown on one boiler. At 12:30 P. M. the second boiler was cut into the header, with about one quarter load. At 1:30 P. M. it had about one half its load, and the third boiler commenced warming up. At 3:55 P. M., commenced to warm up two more boilers. At 6:20 P. M., cut in two of the boilers warming up, making four in use. At 6:40 P. M., cut in the fifth boiler. The load until 10 P. M. continued fairly constant, four

boilers having full load, and one with a partial load. At 10 P. M. one boiler was cut out of use, and some burners shut off on others. At 10:30 P. M., cut out two more boilers.

At 11 P. M. the load was cut down to one sixth of full load on one boiler, another being kept warm and with pressure on it. From 4:45 A. M. until 7:15 A. M. the only load was the condensation of the pipes, and the slow running of one fire pump. The evaporation of practically 13 to 1 made is excellent when the amount of oil consumed in warming up, and in keeping a boiler in constant readiness to cut in, is considered.

The reported results of different experimenters as to the relative values of coal and oil as fuels varies so much that it is impossible to obtain from them any satisfactory basis of comparison.

The Day Cordage Co., of Boston, states that with Cumberland coal at \$4.50 per ton, and liquid fuel at \$1.15 per barrel, they save, by using oil, 15 cents on each 100 horse power hours, without taking into account the saving in not having to handle the coal and ashes.

A barrel of oil will weigh about 300 pounds, and about 2 pounds will give one boiler horse power, or there is 15 cents saved on each 200 pounds of oil burned, so that oil at \$1.37½ equals Cumberland coal at \$4.50.

Cost of oil per pound.....	.00458
Cost of coal per pound.....	.00225
Ratio of oil to coal.....	2 to 1

T. P. Brown, manager of the Toledo, Columbus and Southern Railway, says two barrels of oil equals one ton of soft coal. This would make the ratio over 3 to 1.

Dr. Charles B. Dudley, chemist of the Pennsylvania Railway, in a lecture before the Franklin Institute, 1888, gives the following figures regarding the relative heat-producing power of coal and oil:

	Pounds of Oil.	Pounds of Coal.
Theoretical, anthracite.....	1	1.61
Theoretical, bituminous.....	1	1.37
Urquharts experiments	1	1.756
Peninsular Car Co.....	1	1.742
Elevated Railroad, N. Y.....	1	1.785

Mr. Urquhart's experiments are the result of a year's experience with 140 locomotives using coal and oil. The experiments of the Peninsular Car Company were made in 1885. The experiments on the elevated railroad were made in the summer of 1887.

C. H. Billings, in a report to the Mining Engineers in 1889, gives an evaporation for oil of only 6.64 pounds to 1. This would

show oil to be of less value than coal for fuel, taken weight for weight.

Prof. Potter, of St. Louis, states that experiments at a large works in St. Louis had shown that oil at 3 cents, \$1.26 per barrel, is equivalent to coal at \$2.00. With coal at \$6.00 per ton, not a large price in San Francisco, oil would be worth \$3.78 per barrel.

The figures given by the Standard Oil Company are that three barrels of oil are equivalent to one ton of Illinois block coal, or a ratio of 2.2 to 1. Tests by R. W. Hunt & Co. give for Illinois block coal an evaporation of about 6.8 pounds of water per pound of coal. With the above ratio that would give an evaporation of 14.96 per pound of oil, about what would be right.

The results of certain tests made by the Edison Light and Power Company, of this City, were as follows :

Evaporation with California oil.....	13.1	pounds to 1
“ “ Peru oil.....	12.1	“ to 1
“ “ White Ash coal.....	6.68	“ to 1

The California oil used weighed 320 pounds to the barrel. The Peru oil used weighed 294 pounds to the barrel.

1 pound of California oil = 1.96 pounds of coal.

1 pound of Peru oil = 1.81 pounds of coal.

Assuming White Ash coal to be worth \$6.00 per ton, the equivalent value of

California oil = \$1.68 per barrel.

Peru oil = 1.426 per barrel.

The results of these tests seem low, and probably they cannot be adopted as a safe guide.

Accepting the results at the Midwinter Fair, an evaporation of 15 to 1 can be obtained with oil, using the Heine boilers.

The result of the test of the Heine boiler, made by W. R. Eckart and John T. Wilson, made under instructions of the Pacific Improvement Company, gave an evaporation of 7.6 pounds of water per pound of Carbon Hill coal. This makes the ratio of the value of the oil to Carbon Hill coal of 1.97 to 1. The British thermal units of this coal, as shown by the test, is 11,993. The B. T. U. of the oil is about 20,000, making the theoretical ratio 1.66 to 1.

In comparisons of coal and oil as fuels account is seldom taken of the steam required to spray the oil, and with some burners this may amount to quite a large percentage. A number of tests of the steam-using capacity of the burners at the Fair were made, but the

manner in which the tests were conducted was not such as to give confidence in the results.

After a night's run with a boiler it was laid off, and the steam adjustment of the burners left unchanged. A pipe was fitted over the burner tip, and led outside and into a barrel standing on a pair of scales. The barrel was filled about three fourths full of water. The steam was then turned on all the burners of boiler, a branch pipe from the one leading into the barrel, enabling that burner to be blown through to get dry steam. The steam was then turned into the barrel of water, and allowed to flow for ten minutes. The increase of weight gave the amount of steam used. The amount shown was from 9 per cent. to 10 per cent. of the power developed.

The source of error arises from the fact that when the burner is in actual use, the tip becomes heated to quite a high point by radiation from the furnace, and the difference in expansion of the iron shell and brass tube of the burner makes the steam orifice smaller. The amount of the steam opening is so small that this error becomes very large.

It would have been desirable to place a small boiler on the steam header for the oil line to make consumption tests of the burners, but none were available. Probably the actual amount of steam used in the burners in this case was from 5 per cent. to 6 per cent. of the developed power. A good burner should not use more than 3 per cent. of the steam furnished by the boiler.

There is another item which fully offsets the loss due to steam used in the burners. This is the gain from having no coal or ashes to handle, and the reduced number of men necessary to handle a boiler plant. One man to tend water, and one to tend burners, will handle boilers of from 2,000 to 3,000 horse power.

The following table shows the equivalent prices of oil and Carbon Hill coal, figured on the above ratio of 1.97 to 1, and taking the oil as weighing 310 pounds, which is the result of a number of determinations at the Fair:

$$\frac{2,240 \times \text{price of oil per barrel}}{\text{Weight of oil per barrel} \times \text{ratio of oil to coal}} = \text{Price coal per ton.}$$

Oil per Barrel at	Coal per Ton at	All Economies Considered. Coal per Ton at
\$1.00	\$3.66	\$3.30
1.10	4.03	3.62
1.20	4.40	3.95
1.30	4.77	4.29
1.40	5.14	4.61

Oil per Barrel at	Coal per Ton at	All Economies Con- sidered. Coal per Ton at
1.50	5.51	4.94
1.60	5.87	5.27
1.70	6.23	5.61
1.80	6.59	5.94
1.90	6.95	6.27
2.00	7.21	6.60

The third column is figured on the basis of the statements made by Dr. Charles B. Dudley in his lecture before the Franklin Institute. He gives the relative evaporating powers of oil and coal as 1.75 to 1, and then remarks as follows :

“There are certain chances for economy in burning oil that do not occur with coal. Of these there have been pretty well worked out, as just stated, economy in handling coal and ashes, and economy in repairs. The amount of these has been obtained in dollars and cents, and is, perhaps, best expressed by saying that, taking all ascertained economies into account, a pound of petroleum is as good as two pounds of coal.”

Taking this same proportion the results in the third column are obtained. The direct advantages of the use of oil fuel for generating steam are many. A petroleum fire can be held in perfect control with the greatest ease. The heat produced is more uniform than with wood or coal, and it is much more easy when using oil to keep a uniform steam pressure with a varying load. By turning a valve you can instantly extinguish the fire if occasion does not require its continuous use, and it can be quickly started with a few shavings, or other kindling. When the work is done the fire is instantly shut off, and there is no waste of unburnt fuel, as with coal.

There being no necessity for opening doors for the introduction of fuel, there are no great fluctuations in temperature to induce destructive strains in the boiler. The absence of sulphur in the fuel makes its action on the metal of the boiler less destructive than with many coals. There being no smoke or dust from the oil the tubes and heating surfaces remain clean, and in better condition to transmit heat.

Economy in labor, cleanliness and safety are secured by the use of oil. There is no shovelling of coal and ashes, and consequently there is great saving in labor. The absence of sparks and cinders, and the ability to extinguish the fire instantly in case of danger, makes the use of fuel oil very desirable when considered with a view to safety.

The utilization of oil as fuel for other purposes than the generation of steam is a subject that I hoped to be able to treat at some length this evening, but I have been unable to get sufficient data to do so. The variety of uses to which it has been put by Eastern manufacturers should be a guide to the people of this Coast, and in many cases oil could be substituted for coal with marked economic results, and the production of manufactured articles of a more uniform degree of excellence.

Oil has been utilized in the East for all kinds of forgings, copper-smith's work, heating retorts and furnaces, annealing of all kinds of metals and glass; burning brick, terra cotta, stoneware, cement, sewer pipe and lime in kilns; in smelting works, chemical works, cremating garbage, and numerous other processes.

It offers a means of securing a uniform even degree of heat without sulphur, or other deleterious elements, and it is definitely stated that oil for forging and other similar purposes has a heating value of 3 to 1 as compared with coal, and enables the operator to produce more work than with coal. This last is self evident when the time the average workman consumes in tinkering with his fire is taken into consideration.

It is probable that there is not an establishment in this City in which any smithy work is done that could not save money by using oil fuel. Its use in brass foundries should be attended with economic results, and there is no reason to doubt that it can be successfully used to melt iron in a cupola or reverberatory furnace.

A heating furnace for heating shapes for bending has been erected at the Mare Island Navy Yard, and gives every satisfaction. It is also in use at the Pacific Rolling Mills, and it is to be hoped that some member present may be able to speak regarding its use there.

In most places where oil is used, aside from places where used for generation of steam, compressed air is employed for spraying it, but the absolute necessity for this is doubtful. With a proper burner, and superheated steam, equally as good results could probably be obtained.

The Syracuse Chilled Plow Company reports that $14\frac{1}{2}$ gallons of oil is equivalent to 550 pounds of the best hard coal for their uses.

The Walter A. Wood Mowing & Reaping Machine Company, of Hoosic Falls, reports that it takes 1,100 gallons of oil to thoroughly anneal 16 tons of castings.

Most of the manufacturers in and around Los Angeles have adopted oil as a fuel for all purposes, largely because of its cheapness, but very few of them could be induced to return to the use of coal, even if it were brought down to an equivalent price with the oil.

The increased activity in the oil fields of this State, the number of new wells which are being sunk in the neighborhood of Los Angeles, and the importation of the Peru oil, make the subject of its use as fuel one that should interest the manufacturers of this Coast, and I ask the members present to criticise this paper as read, and to add any experience they may have had with oil, and the results of such experience, either for or against its use.

THE TECHNICAL SOCIETY OF THE PACIFIC COAST.

This Association held their regular monthly meeting on the second day of last month, Mr. G. W. Dickie presiding.

Mr. Charles L. Pioda, C. E., of Santa Cruz, Cal., was elected to membership, and two applications for membership were received and referred.

The Secretary announced the death of Julius H. Striedinger, some weeks ago, in Mexico, a prominent member of the Society, and an engineer widely known in this country in connection with various public works, the East River improvements at New York among others.

No regular paper was presented, but there was an extended discussion of a previous one on "The Relation of Transportation to Production in California."

A communication was received from the Association of Engineering Societies, Boston, Mass., relating to an affiliation of the Technical Society with that Association. This matter will come up for action in the future, when further particulars are learned of the Eastern Association.

At the next regular meeting, on Friday, Dec. 7th, there will be presented a paper on "Timber Preserving Methods," by W. G. Curtis, which will be read and submitted for discussion.

GEORGE W. DICKIE.*

Mr. Dickie, the manager of the Union Iron Works, at San Francisco, is, no doubt, as widely known as any American engineer of our time, not in a popular way, perhaps, but among the advanced engineering industries of this and other countries, and we might add, especially abroad, where his professional work of one kind or another has attracted much attention in mining, hydraulics, steam engineering and shipbuilding.

Mr. Dickie is a native of Scotland, born at Arbroath, near Dundee, in 1844. The family are shipbuilders, and have been for centuries. His father, who died at San Mateo, California, in 1893, once remarked to the writer in respect to the family: "The Dickies have been shipbuilders for nearly four hundred years," so there is the advantage of heredity in the part this family has had in shipbuilding on the Pacific Coast. They have been directly connected with the construction of every deep-sea vessel built at San Francisco since 1869.

By family is meant Mr. James Dickie, the shipbuilder of the Union Iron Works; Mr. John Dickie, shipbuilder, representing the business of Dickie Bros.; Mr. William Dickie, senior, the father before mentioned, and, most conspicuously, the subject of these notes. Mr. G. W. Dickie was educated in the "Scotch schools," which means something quite different from a common school education here; was trained in constructive engineering in the works of the North British Railway, and in his father's shipbuilding yard, on the Tay.

Owing to business reverses in Scotland, the family decided in 1869 to remove to the New World, and San Francisco was selected as the place where shipbuilding was most likely to become a leading industry. On arriving at that City there was little business in the way of marine work, and Mr. Dickie, to fill in the time, applied at the Risdon Iron Works, in San Francisco, in response to an advertisement for an engineer to carry out the construction of the city gas works, then projected. His versatility and powers of observation here came into play. As he naively remarked once to the writer: "I had nothing to 'unlearn' on the subject of gas making." He secured the position, went on and carried out the work in a very successful manner, and became an "authority on gas."

The great Palace Hotel was then being built, and the hydraulic elevator plant was undertaken by the Risdon Iron Works. The work was designed by Mr. Dickie, on the Armstrong differential system, so successfully that for eighteen years successive improvements did not call for modification, and it is likely that for ten years of that period it was the most advanced practice of the time. There are five different elevators, the cage in one case moving seventy-five feet

*J. Richards, in the *American Shipbuilder*.

per minute. The valves were controlled by hydraulic pressure, and the main elements of the plant are yet in use.

An opportunity soon occurred for entering on marine work. A surface condenser was wanted for a steamer, and Mr. Dickie gladly dropped the role of gas and hydraulic engineer to enter the more familiar field, and as he once remarked: "From that time on the Dickies were connected with all the shipbuilding and marine engineering done at San Francisco." About twenty years ago Mr. Dickie urged the expediency of the composite system of shipbuilding on the Pacific Coast, the fine fir timber there being especially suitable for planking, but it was hard to awaken interest or understanding in this matter. He prepared drawings involving months of work, and the most elaborate we have ever seen, to illustrate the method of constructing a 2,500-ton ship on the "composite" system, showing all the details down to the most minute thing, all colored and shaded in a manner now unknown to the draughtsman's art. These drawings were sent as an exhibit to the Eighth Industrial Exhibition, held in San Francisco. Of this matter Mr. Dickie recently remarked: "Judge of my surprise when I found the committee on classification had placed my drawings among the Chinese curiosities." We regret to repeat this story, but it must be remembered that to a possible committee of the kind it was hard to distinguish between the colored sections of a steamship and the ornate Asiatic characters on a tea box. These drawings can be seen at the Union Iron Works now. They were substantially reproduced in engravings made in 1891, to be used in connection with an address by Mr. Dickie, delivered at the Academy of Sciences, San Francisco, on the commerce of that port. We will quote a few sentences from the introductory part of his address:

"Nothing is more marked in the past history of the world than the struggles of commerce to establish conditions of security and practical means of communication with distant parts. When driven from the land by restrictions and imposts it would seek for freedom and safety in the sea. If Rome was all powerful on the land, Carthage ruled on the sea. The strength of Rome was in her legions, that of Carthage in her ships, and her ships could cover ground that the legions could not reach. She stretched her commerce beyond the mystic pillars of Hercules into the Atlantic, and founded the port of Cadiz. Later, the Venetian refugees, stretching their hands over the sea, found in its fish and salt, and in the rich commerce it opened up to them, more than compensation for the fat lands and inland towns from which they had been driven, so that in course of time, from the security of her position, and the enterprise of her merchants, Venice became practically mistress of the sea. * *

"It is London's doorway to the ocean by the Thames that makes her the commercial head of England. Liverpool has become great and wealthy by making the most of her door by the Mersey, and Manchester is now spending many millions to get at the same door. * * * * *

"New York, Boston, Philadelphia, New Orleans, are all great commercial centers, because they are careful to make a proper use of their position, entering their imports by their own 'front door.'"

The figures and quantities given in this address showed a remarkable knowledge of maritime and commercial matters, as well as engineering. Mr. Dickie was connected with the Risdon Iron Works fifteen years. His designs for marine engines became a recognized type on the Pacific Coast. Thirty-six ships were built during this time, the steamship *Mexico* being the largest, and the Pacific steam whaling fleet the most original examples. The *Balaena* of this fleet, built in 1882, has in her the first triple-expansion engine designed and built in this country, and these now combine all the advantages of the most advanced types. During this fifteen years Mr. Dickie participated in designing and building the enormous machinery erected on the Comstock Lode, at Virginia City, Nevada, among other things the great hydraulic pump at the combination shaft. For a short description of this pump, which we saw in 1879: It was 60 feet long, 22 feet wide and 17 feet high, and cost \$250,000. It was as a machine the most impressive creation of the workshop, considering its size and complication of steam and hydraulic elements, ever produced on this continent.

In 1882 Mr. Dickie urged the Risdon Iron Works to prepare for iron and steel shipbuilding, which they naturally feared to undertake, and he attempted to organize an independent company to carry out his plans. While thus engaged, Mr. Irving M. Scott, of the Union Iron Works, at San Francisco, informed Mr. Dickie that his company had this matter in view, and had secured the necessary lands at the Potrero, and invited him to join in the enterprise. This was done. The new Union Iron Works were completed in 1883, was and is the best equipped plant of the kind in this country. The implements, of which at least one half are of special construction, are for shipbuilding and marine engine work. The works covered at first fourteen acres, but have since been extended. The financial management of the president, Mr. H. T. Scott; the executive ability of the general manager, Mr. I. M. Scott, and the mechanical skill of the manager, Mr. Dickie, have built up on the western side of the continent a monument to American enterprise that has scarcely a parallel. The vessels constructed for the United States Navy at these works alone form a foundation broad enough for a great reputation.

The hydraulic lift dock at these works, that cost half a million dollars, has raised over a thousand ships without accident of any kind. This dock, designed by Mr. Dickie, and carried out for the company under his instructions, is a remarkable work of the kind, that has attracted the attention of engineers in all parts of the world. In the naval division of the Engineering Congress, at Chicago, in 1893, Mr. Dickie took a prominent part, as will be seen by the extensive portion he contributed in the published transactions of that body. He was one of the founders of the Technical Society

of the Pacific Coast, and, so far as his arduous duties have permitted, has always contributed to the work of that association, of which he is now the vice-president.

Mr. Dickie, like many other busy men in the world, has a "hobby," or rather has a scheme which his own knowledge, technical and commercial, has carried far beyond the grasp of most other people. It is the establishment of a great steamship line between New York and San Francisco, via the Straits of Magellan. His figures on this subject are of much interest, and are alike astonishing and incontestible. They have withstood the test of skilled criticism in this country and in Europe. Let us hope he will live to see the consummation of his plans.

Disregarding here, at the end, an injunction to put "nothing personal in these notes," we will say that Mr. Dickie is in the prime of life, with a full measure of physical and mental powers to draw upon in future. He finds time to lecture on various topics; assists in the government of the beautiful town of San Mateo, where he resides; also to give careful attention to an ideal home with five sons, who by tradition and sequence should all be shipbuilders.

LAKEPORT COUNTY FAIR.

Lake County, its middle within a little more than one hundred miles of San Francisco, occupies a basin in the Coast Range of mountains with Clear Lake as a center. This lake is 30 miles long, and two to ten miles wide, fed by innumerable springs and brooks, also by higher and smaller lakes to the northwest, the water overflowing through Cache Creek to the Sacramento River, southeast.

A distinguishing feature of this romantic basin, which lies 1,300 feet above the sea, is in the great number and variety of mineral springs that exist on nearly all sides of the lake. At "Seigler," which is perhaps the principal resort of all, there are more than 30 different springs, varying from 50 to 150 degrees of temperature, containing iron, sulphur, magnesia, arsenic, soda and gas, a medley of mineral salts that must be derived from an exceptional geological formation. Another unexpected feature is the fertility of this mountain country, and the varied growths of all kinds possible there, from the lake level to a thousand or fifteen hundred feet above.

We attended the County Fair at Lakeport, in October, and looked wisely at the farm products of the region, a farmer pointing out the different things and giving their names. One thing was distinguished without aid, pumpkins, but there was a mental reserve when the weight was given at 130 pounds for one specimen. Beets 25 pounds, potatoes 5 pounds, maize 14 feet high, are found among our notes, and were seen and examined.

The fruit of all kinds bears the impress of climate, and the colder winter season. There is an aroma and concentration of both acid and sugar common to fruits grown in the higher altitudes and frost. This may be a heretical proposition, or a fancy, but it is maintained. The best fruit examined was grown on the chaparral grounds, where one would suppose nothing but sedgebrush could live, at least it looks that way. In a collection of plants and shrubbery were caoutchouc, cinnamon and camphor trees, a most remarkable growth for this country. There was no mistake of the genuineness of the trees. The odor proved that.

As remarked, the whole of this great basin of Lake County is fertile even to the top of the mountains. There is no barren ruggedness as in most other parts of like contour, in fact nearly the whole face of the country is timbered, and on the upper benches heavily timbered with a kind of nut pine, oak and other trees.

It is not, however, the agricultural resources of the county, its pumpkins, apples or trees, that it is the purpose to notice, but the remarkable fact that within a hundred miles or so from San Francisco is one of the most attractive resorts in the world, and where there is more of what we call natural phenomena. No other city of any size in this country, and not likely any city in the world, has such a resort within easy distance, and possessing ideal features of climate, scenery and healthiness.

On the western and most accessible side of the lake is a large mountain that extends for ten miles or so parallel to the lake, and 1,500 to 2,000 feet above it. On the eastern side of this mountain over an area of twenty or more square miles there are no springs. The rainfall on this slope must be thirty-six to forty-eight inches a year, and the query is, where does this water go? A solution is that the formation, or strata, shelves back from the lake, and the water, after percolation into the mountain, rises beneath the lake in the form of springs. A proof of this is shown in the remarkable springs at Soda Bay, where one some distance out in the lake has a flow of 1,500 to 2,000 gallons per minute, a flood of water charged with carbonic acid gas so it comes up in a foam, giving off so much gas as to make it dangerous to bathe in, unless there is free escape for the gas. This enormous spring is not all. There are many more, some of them visible by agitation of the water, and gas is given off over a large area. The water is charged with minerals, pleasant to the taste and tepid in temperature.

EXTRACTS FROM A NOTE-BOOK.

BY "TECHNO"

No. XXVI.

A MONOLOGUE ON THE MISSISSIPPI.—HOW A RIVER OPERATES.—WHAT
A MILLION IS.—WHAT ONE GAINS BY OBSERVING.

A HOMILY ON HUMAN EFFORT.

—————The Mississippi flowed before us here in St. Louis. I had seen it before, but it looked dwarfed now, and crawled beneath the great steel bridge in a sullen, sleepy kind of way. I knew very little about the river, except the school-boy lore, which is as near nothing as one can imagine, but I soon learned more.

My Uncle had fallen in with some old friends, none of them steamboat men now, but captains nearly all. Some were merchants, some traders, and some nothing but owners of a lively recollection, tempered as one might infer with a strong flavor of imagination.

We were assembled on the hotel veranda, and after a pause, an old Captain Somebody, said to my Uncle: "Camshaft, you were always eyes all over, saw everything, pried into everything, comparing, figuring, reading and remembering, now just tell us how the old river compares with other rivers you have seen. I know it is a good many years since you took to salt water, as I always knew you would sometime, but you remember the river."

This was just what I was waiting for. The subject was a congenial one for my Uncle, and I got out my note-book at once. Here are the notes:

"The Mississippi River is four thousand miles long, counting the Missouri, which should be called the Mississippi. It is the main stem as to length, but right here let me say the length of river has nothing to do with its size. Most people imagine that the water from the little lake at the head finds its way to the gulf. It is no such thing. If there was not a continual accretion of water all along the way, the river would run out and dry up long before it reaches New Orleans, or here even, like some rivers do half way up from their mouths. Here Tech! do some figuring for me.

"Take a thousand miles of this river from here to Natchez a mile wide, and see how many square miles that will make. One thousand. Of course it would. Now tell me how much water it will take to cover a square mile one fourth of an inch deep. One

square mile = 640 acres = 27,878,400 square feet—divided by 48 to find the volume of the $\frac{1}{4}$ inch in cubic feet, gives 580,800, multiplied by 1,000 gives 580,800,000 cubic feet.

"Might just as well be half as much or twice as much," said my Uncle. "The figures convey no figure or conception to the mind, but this is the amount of water that will evaporate in one hot day all over the river between here and Natchez, and if there was no accretion of water, the river would not reach there, but all be dried up on the way. There are more than fifty rivers large enough to steamboat in, that empty into this great drainway. The water here is not what enters the gulf at all.

"The river down at Cairo is a mile wide, and averages about 90 feet of depth from there to New Orleans. It is the largest river in the world by volume and length, the volume is made up by a velocity of four miles an hour. A river may be five miles wide and have half the volume of flow. The Amazon toward its mouth is an example. But not in water alone is this river ahead. It carries more mud than all the rest combined. This I suppose you know from the mixture you have been drinking. Some one curious in such matters computes that six millions tons of earth is carried down annually. He might just as well have said sixty millions. As I said before, one cannot conceive of such a quantity, it should be expressed in mountains, farms, or square miles of territory.

"This mud comes out of the Missouri River, nearly all of it. The mouth is just above here, and will be here soon, at the rate it is moving down stream. The Missouri, contrary to all rules for river construction, is a rapid stream in an alluvial bed that shifts about so much that it keeps on top, which is a fortunate matter, otherwise it would cut out a channel half a mile deep, and spoil all the cornfields along the route.

"The Mississippi Valley means between the Alleghany and the Rocky mountain ranges, as we commonly say. It means about three fourths of this country, and nearly as much in area as all the principal countries of Europe, Russia excepted.

"The sinuosity is unaccountable for, no one can explain why a river should go meandering around right and left, making up in a thousand miles from here five hundred of lost distance. Fifty per cent. is deviation. What this is for, what the cause and wherefore no one knows, unless it be to prevent the whole valley from being sawed in two pieces, as would soon occur if the river was straight, and stationary.

"As it is, there is continual turmoil for thousands of miles, especially on the Missouri branch. People and towns are shifted from one State to another, and people on the banks and islands don't know where to vote or pay their taxes. Islands come and go. The channel is first one place and then another. In my time you could always detect a Missouri River pilot, by the nature and vigor of his profanity. It was a distilled essence one might say, and it is just the same now, I mean the river, only freights are so low that a man cannot afford a new steamboat every fourth trip or so, the traffic has nearly ended, has also become dangerous in proportion, because boats have to pass pretty often to find where the channel is.

"Sometimes, or quite often indeed, the whole river scatters over the country, like the Skärgord in Sweden; scatters so there is no telling if it all finds the way back. It does not indeed, and here comes another idea about rivers, an idea that shows how we act and think on impressions instead of facts. Saturate a sponge and lay it down, a small trickle of water will run off, but the main body remains in the sponge. Fill up the sponge once an hour, and you have a figure of the basin of a river. The bed is filled up once a year, and the water passing here is a mere trickle compared to the whole volume, the surface water, so to speak. Dry out the bed of this river, and it is not likely that a drop of water would run here for twenty years to come.

"The Mississippi, as I said, is a mile wide from Cairo to Vicksburg, then grows narrower, and from New Orleans to Belize is only half a mile wide, but a little deeper, not deep enough however to represent the continued accretion of water on the way. The subterranean feature of rivers is the most wonderful part. The rise and fall here and for a long way down is about fifty feet, then less and less, and only one fourth as much at New Orleans, nine feet some will tell, but it is more—fourteen perhaps. It has spilled out, gone up into the air, over and through the banks and levees, a good deal down the bayous, such as La Fourche and Plaquemine two hundred miles from the real mouth, but are mouths themselves in a sense.

"It is a queer river, a wild raging river with a water shed three thousand miles one way and two thousand the other, which multiplied together give six millions, and again I say, might as well be six hundred millions, in so far as giving one an idea of quantity or dimensions. A million is a nonentity, no one comprehends it, that is, it conveys no tangible idea of number or dimensions, it is only a figure to be split up into smaller dimensions, but this Missis-

issippi Valley too is nearly in the same category, one can get a map idea of it, no more."

—————This was the longest continued lecture I had ever secured for my notes, and was of much interest to the company. It also led up to a new idea or observed fact on my part, namely : mankind are unconsciously divided into those who deal with reason over what is seen, and those who go on inductively to deal with and reason over what is not seen, but implied. To some, nature is a book full of hidden meanings and signs that to others are plain visible facts.

A chemist for example, in looking at substances, sees them as a combination of elements or gases. He is like a person travelling in a land where his own language is used. He reads the signs, the newspapers, hears all that is said, and understands it, but shift him to another land with a strange language, where his eyes, ears and tongue are of little use, and he is in the position of one without scientific knowledge.

He sees rivers flow, movement all around, but does not know what causes it, he sees rain fall, but does not know from whence it came or whither it goes. Plant life, animal life and physical laws, are all hidden behind an inscrutable veil, and he goes on groping in the dark, and is happy, so long as he does not know there is more to be understood.

Then again comes the question, what does a person gain by this faculty or qualification of understanding things? Answer — nothing. It is only others that gain. Education constitutes a man a martyr, opening to his eyes wide fields of effort and labor, solely for others, his little part being only the exercise of faculties that physically he would be better without.

Many a time have I thought how this prying investigating faculty of my Uncle had brought him a life of toil and labor, the fruits of which were scattered over a wide field, beside the little scraps that fell to my lot, and to these notes. Suppose instead that he had confined his time, thoughts and energies to making shoes, all alike, year in and year out, eating his poor bread in comfort, and never looked outside a little shop, or reached beyond his cobbler's bench, run the long race happily, honestly, and at the end without enemies, laid down in peace, his corporal part to be resolved into gases, the existence of which he possessed no knowledge or hint, and his spirit to that gaol where the best of us tend ; would not this have been a more happy life? Who knows?

(To be Continued.)

REGULATION BY INERTIA.

Mr. Henry J. Conant contributed in the *Engineering Magazine*, for October, an article on "The Development of Steam-Engine Governors" that, from a practical standpoint of view, is the best that has appeared on the subject.

He traces the history of centrifugal regulators in their principal modifications from Watt down to, and including, the inertia governor, if that can be considered "centrifugal," and gives his unqualified approval of this method, illustrating it by the Siemens' governor. This consists in interposing in a train or set of wheels to drive the governor, an intermediate moving wheel attached to the engine-regulating gearing, so the slightest change of the engine's speed acts at once for regulation independent of change in the centrifugal elements.

This latter is a very ingenious and efficient device, but is only an extension of the Sergeant governor invented thirty-four years ago,* and applied on some of the U. S. war vessels to prevent racing.

Sergeant has as to movements, the same arrangement of wheels, but a much better apparatus, consisting of a spur wheel, and an internal gear wheel, and a movable pinion between and meshing into both, so the slightest change of speed of the spur wheel, connected from the engine shaft, advanced or rolled back the pinion which was attached to the throttle valve. The difference, however, from Siemens' was that instead of a centrifugal governor at the end of the train, Sergeant employed a small independent engine running without load and presumably at a constant speed. This was a true inertia system in so far as the method of operation, and deserves the term as much as the Siemens' modification.

The first inertia regulator for steam engines wherein the relation of a revolving mass to the engine shaft determined the steam distribution is, so far as we know, to be found in the patent of C. B. V. Downing, of San Francisco, No. 227,967, dated May 25th, 1880, and had he, or his patent agents, comprehended the invention, and set it forth in proper terms, and made such claims as the scope of the invention permitted, all subsequent apparatus of this kind would have been tributary to Downing's patent.

The following quotations from the specification taken from different places will indicate the nature of the invention :

*H. C. Sergeant, Patent No. 23,380, dated Dec. 21st, 1858.

"My invention relates to certain improvements in controlling the quantity of steam which is admitted to the cylinders of steam engines, and it may also be applied to any engine which is driven by a vapor, gas or fluid under pressure.

It consists in varying the size of the openings by which steam is admitted into the cylinder by means of a novel mechanism, which is so connected with the engine shaft that the opening made by the valve in passing over the port is altered by the increase or decrease of the load upon the shaft, thus forming a cut-off and governing device, which is adjusted by the increase or decrease of the work.

I have shown my invention applied to this form of engine, but it will be manifest that it is equally applicable to engines using puppet valves, and to other forms, with slight modifications of some of the parts. In the present case the valve is actuated by an eccentric.

Whenever the load increases sufficiently to overcome the resistance of the spring the pulley F will turn upon the shaft, and by means of the lever I will move the eccentric so as to change its center of motion and increase its throw, and this will increase the opening of the valve proportionately with the increased load.

Any sudden increase or decrease, such as would result from the racing of a propeller in a heavy sea, or the sudden change of load in other cases where the engine ordinarily undergoes severe strains, would be instantaneously compensated by a change in the opening of the valve, and this change is so rapidly effected that the speed of the engine would not be perceptibly altered."

This, while it mentions the driving power as the element of control, really means the inertia of the fly wheel, which was loosely mounted on the main shaft of the engine.

To this was appended a simple claim "on the mechanism" that in no way recognizes or includes the main points of the invention, so the patent proved of no value by reason of an imperfect specification. Downing made a model of his regulating gearing, from which the drawings were prepared as they stand in his patent. This model, which we examined some years ago, is yet somewhere in this City. Downing died soon after the issue of the patent.

This inertia system, or differential system, which is a better name, is now in course of evolution, and in this City is applied to water wheels, electric motors and to steam engines. One can easily accept Mr. Conant's views of the method being ultimate in so far as its employment for regulation of inherent forces set up in a steam engine.

TESLA'S STEAM ENGINE.

Now and then comes a few words respecting Mr. Tesla's vibratory direct-generating engine, or steam dynamo. The scheme is to produce electric current without rotary movement, friction, or moving joints even, except of a steam piston, which directly vibrates or reciprocates, we may say, an armature between magnets. There is nothing improbable in this. The range and momentum Mr. Tesla proposes to overcome, or compensate with springs, showing a clear conception of the dynamic forces that a crank deals with.

Six months or more ago Mr. Tesla gave out the following particulars of his direct steam engine. It is interesting and suggestive.

"I had gone considerably into the study of the practical aspects of the work which I was to present, and my notion was that I was touching upon something which would lay the foundations of a novel industry, perhaps of more than one industry. I dwelt chiefly on those features which possessed a purely scientific interest, my desire being to present the subject very modestly, as I was not quite sure of some of the questions involved. A prominent engineer came to me and said: 'Mr. Tesla, I want to tell you something, but I fear it may offend you.' I knew what was coming, and so I asked what it was. He said: 'Well, don't you work on steam engines. You have done some work in electricity. If you stick to it you will do some good work, but if you work on steam engines you are bound to fail.' Another, to whom I showed the advantage of doing away with complicated mechanism, and generating electricity directly, said, after he had watched it for a long time, 'couldn't you apply this to rotating motion?'

One of the first impulses which guided me was to produce an absolutely constant motion, which would be independent of any friction losses, or gravity, or temperature changes within very minute limits. I wanted to produce a positive motion, so that I might operate what I called a disruptive discharge coil. With a device which I invented I was able to maintain a vibration with perfect constancy. The device consisted of a spring which required several tons of force to spring a certain distance, and which was constantly kept in vibration by steam pressure or air pressure. In the beginning I used springs of tempered steel. These steel springs would break, though they had a section of two or three square inches. So I resorted to air springs. The air springs would not break, but they had no constant resistance. Then I made the chambers of the air springs communicate with the outer air. This device yields a constant vibration, and as the force which is driving it is many tons, and the friction but a very small matter, it is unaffected by the pressure, so I have a constant vibration. This is the device

which I believe will be used for many purposes, for instance, for governing all sorts of mechanisms, engines, and so on. It contains much of interest for scientific men, because with it I am now able to produce currents of perfectly constant frequency.

When we look at a steam engine, and inquire where the power comes from that drives the steam engine, we will always find that the power comes from a little box, a cylinder with a piston in it, and all the other appurtenances are really but to keep it going. My first idea was to apply the motion of the piston, which is freely movable, to a magnetic field, to move a magnet or coil in a magnetic field, and so generate currents by this direct motion. We can reduce the weight of the engine for the same pressure and the same piston speed to $\frac{1}{30}$ or one $\frac{1}{40}$, if not $\frac{1}{50}$, of its weight. We do away with all mechanical frictions.

The engine designed according to my ideas has a mechanical efficiency of $99\frac{3}{4}$ per cent. In my construction the dynamo may consist of a simple coil of the magnet, and a simpler coil, which is all immersed in the magnetic field. There is no useless wire, consequently dynamo and engine, if they are reduced considerably in weight, increase in efficiency. There is only one engine that can equal it in output, and that is the turbine. With the steam turbine we can obtain an enormous output, and that is the reason why the steam turbine, in my opinion, may be found a valuable adaptation for driving dynamos. In reciprocating mechanisms we can expand the steam at an enormous rate. It is perfectly practicable in these mechanisms which I have been working up to obtain, if you want, a speed of 100 meters a second, and while I do not contemplate producing such speeds, yet it is quite possible to do it. As I am enabled now to work without a packing, the expansion occurs at an enormous rate, and the engine being of such character that the exhaust can be readily reduced to pretty nearly the atmospheric pressure, the mechanical friction is reduced to such a small figure that we can raise the temperature of the steam very considerably.

I am now preparing a boiler which will give me up to 350 pounds pressure. If we want to drive motors we must have a long stroke and a slow frequency, if we want to light lamps then we want a very short stroke and a very rapid motion. It is very important in this mechanism, in which the power depends on the square, to obtain as high a pressure as possible. It is more economical to produce rapid vibrations than low vibrations. But, so far as the economy of the dynamo and of the engine is concerned, it is better to produce a long stroke, because a long stroke means a high velocity. I think I am not mistaken in believing that we are going very shortly to have a means at hand of producing twice as much electricity from coal as we can produce at the present time. This is subject, of course, to a test, but I am quite confident it can be done."

BOOKS RECEIVED.

Public Works.—By Ernest McCullough. Published by the author, San Francisco.

Transactions of the American Institute of Mining Engineers.—Oct. 1894.

Monthly Bulletin of the Bureau of the American Republics.—August, September, and October 1894.

Annual Report of the Chief of the Bureau of Steam Engineering, for 1894.

Thirteenth Biennial Report of the State Board of Fish Commissioners, California.

Repair and Maintenance of Machinery.—By Thos. W. Barber, C. E. Spon & Chamberlain, New York.

Practical Design of Structural Iron Work.—By Henry Adams, C. E. Spon & Chamberlain, New York.

Reports of the Chief of the Bureau of Steam Engineering and of the Bureau of Construction, U. S. N., 1894.

Report of the Chief of the Division of Forestry.—United States Agricultural Department, 1893.

Annual Report of the Board of Education, Los Angeles, Cal., 1893-94.

Transactions of the American Institute of Electrical Engineers, Oct. 1894.

 LOCAL NOTES.

Messrs. Laver & Mullany, architects, of this City, have designed, and the *California Architect* has published, an elevation of a competitive design for a Statehouse at Olympia, Washington, that by any fair standard is grand and complete, without whim or excrecence, ornate to the limit of good taste, and imposing by its proportions. People not architects judge as they do of paintings, when they see a new building or a drawing of one. These opinions are derived from impression, and such views, by the way, are apt to be correct, that is, according to a fixed standard. Of course the circumstances of the time or age have to be considered. There is fashion or style permissible in private buildings, and to some extent in public ones, but the main elements in the latter should be "orthodox" and enduring.

The meeting of the State Mining Convention, in this City, on the 19th of last month, with some useful work incorporated a good deal that to people, not miners, looks like chaff. Neither the miners nor the mining interests are persecuted in the manner to be

inferred from the speeches made before the convention. Self interest, as well as a sense of justice, do not permit antagonism, and much less persecution of the miner on this Coast, but it is hard to see why the manufacturers, merchants, and especially farmers, are not equally entitled to aid from the General Government if such aid is to be given to local industry of any kind. No one is hindered from mining so long as he keeps within his own domain, and does not interfere with the property of other people. This is what the rest of the community must do, and is just. In so far as railway appropriation of mineral lands, that is another question, that should have occupied even more attention than it received at the convention.

Messrs. Adam Schilling & Sons, of this City, makers of gas engines and other machinery, have constructed a petroleum wagon for common roads, that as a new attempt is the best schemed piece of mechanism we have seen for a long time. The principal feature is what is "left off." In most applications of the kind there is a wilderness of details—screws, levers, clutches, valves, shafts, wheels, and so on, so that if the integrity of the machines depended on each detail, failure would be certain. Messrs. Schilling have certainly had this impediment in view, and have mounted a pair of gas cylinders and their required accessories in a manner that makes the machinery seem an inconsiderable part. We do not know the purposes of the wagon or carriage, but feel quite sure it will "go," and "continue to go."

We have received from Prof. Friedrich Autenheimer, director of the Technological College, Winterthur, Switzerland, an essay entitled: *Schwächung des Arbeitsvermögens der Materialien durch Spannungswechsel*, which may be translated: "The Weakening or Deterioration of the Working Strength of Materials by Change of Stress." This work, which we have not yet examined, seems to be directed to a new field of inquiry in respect to the effect produced by reversing strains, as in the case of cranks, wire ropes bending over pulleys, and various elements of reciprocal gearing where the moments of stress are continually reversed in direction. The deductions seem to be mathematically presented and then proved by practical tests so far as experiments have been conducted. The changes of molecular structure due to stress, of which but little is known except as to the fact of there being such change, present a

field of interesting and, no doubt, valuable inquiry. The phenomenon of crystallization may here find explanation, also the flow or possible distortion of crystalline substances. In a practical way it may afford explanation and a remedy for the breaking of crank shafts, and even the rupture of steam boilers. A further notice will be given of Prof. Autenheimer's researches and experiments.

Chief Constructor A. W. Stahl, U. S. N., who has for several years been on duty at the Union Iron Works in this City, has been ordered to the Washington Navy Yard, the most important post in the Department in respect to constructive engineering work, an honor and promotion that are well deserved. Constructor Stahl has been a very successful officer, an ideal one, as might be said, possessing all the qualities required for the responsible duties that attach to his profession, not only as a naval constructor, but as an engineer, and in the adjustment of technical and judicial problems that arise in the service. It is not easy to retain in the service men of Constructor Stahl's ability, and the Department came near losing him some years ago, when nothing but a high sense of duty prevented his accepting positions of greater emolument and fame. He leaves here a worthy remembrance of his interest in and contributions to the advancement of technical knowledge on this Coast, also many warm friends who will be interested in his future career.

In a foreign journal we find the statement that American makers of steel rails have recently taken orders for 18,000 tons of steel rails in "neutral markets" against English bids for the same work. There is nothing improbable in this, and there will be many repetitions no doubt, in the near future. In estimating the causes that enable an export trade, or export prices, people hardly ever go farther than iron ore, fuel and wages. These are, of course, the main elements that go to make up the cost of steel rails, but there are other things, many of them. The expense account, the next largest item in cost, is reduced or increased by general prices. Wages follow, also the prices of essential commodities, but are lower now "per ton" in this country than in England, at least are in modern mills, such as those of Carnegie, the Illinois Steel Works, and others having a full modern equipment.

COMMENTS.

How much attention this Journal has called to the platform and stairs system of getting into and out of railway carriages in this country, is not known. The subject has been brought up regularly for six years past, until now it is likely to pass into other hands. The serial literature of October brought out several articles on the subject, one in *Scribner's Magazine*, and another in a railway journal, also the statement that Pennsylvania lines were about to make or adopt side-entrance cars for a part of their service. The reasons that cause our railways to put platforms on the cars, and haul them with trains, is not very easy to detect. It is mainly to avoid platforms at the stations, or to avoid stations altogether in some places; also to avoid the expense of running "through" instead of "past" stations. The station at Oakland, Cal., comes nearest to being a "run through" station than any we can think of, but even there no platforms are employed. In St. Louis, Kansas City, and indeed in nearly all Western cities, one has to cross a number of lines to get to, or from a train.

The Manufacturers Association of Cincinnati and Hamilton County, Ohio, have issued a call for a National Manufacturers Conference, to be held in that city, on January, 22nd, 1895, with a view to founding a National Association of the kind. Among the objects are named.

"The advocacy of carefully considered legislation, to encourage manufacturing industries of all classes, throughout the country.

The discussion of ways and means, whereby trade relations between the United States and foreign countries may be developed and extended.

The establishment in South American capitals and other desirable points of permanent expositions for the display of American products.

Such other topics as may be agreed upon by the Convention.

It is desired that this Convention shall be non-political, non-partisan and non-sectional."

A hopeful and commendable sign, is the proposed improvement of coke-making processes in this country, which will likely be remodeled on the German system, so as to increase the amount of

coke about ten per cent. and utilize the by-products, consisting of tar, sulphate of ammonia and surplus gas given off during the coking of the coal. This is the true way of protecting our industries, by making it impossible to compete. Coke it is true, is not an article of importation, but the same rule applies to all kinds of industry. Coke making is one of the most important, on which depends various other interests more extensive still, and there is no doubt of a neglect of various refinements, which the consummate chemical skill of Germany can furnish. Indeed a good share of Germany's foreign trade is rendered possible, by methods arising out of wide-spread technical knowledge in that country. The many schools founded there about twenty years ago, have just "come to bearing," as the fruit growers say.

The German Government has adopted a new law and procedure in trade-marks, and has, as in this country, transferred the Bureau and business to the Patent Office at Berlin, and combined the two departments. Existing trade-marks are to be re-registered at Berlin, and new applications will be governed by a new set of rules, some of which are as follows :

"What constitutes a Mark.—Any distinctive sign or emblem serving to distinguish the products of a manufacture or the articles of a commerce.

What does not constitute a Mark.—(1) A mark composed exclusively of cyphers, letters or words descriptive of the manner, time and place of manufacture, or of the nature, purpose, price, quantity or weight of the goods. (2) A mark containing home or foreign coats of arms, or the coat of arms of a German territory, community or union. (3) A mark containing representations either contrary to morals, or misleading and likely to create confusion.

Treaties of Reciprocity.—Foreigners can only obtain trade-mark protection in Germany, if German tradesmen can obtain similar protection in the country of such foreigners. Foreigners applying for registration in Germany must show that they have secured protection in their own country."

The Franklin Institute is becoming venerable. It was founded in 1824 to promote the mechanic arts, but "science" was at a later period included in the title. The home of the Institute is a massive granite front building, on seventh street, in Philadelphia, containing a library of 40,400 volumes, all of a "solid" character, no fiction or "trash." There are also 26,000 pamphlets, and 1,100 photographs, with quite a museum of models and examples of machines, and

curious structural work. The theatre or lecture hall, is commodious, and there are a number of offices for committees, and the transaction of business connected with the Institute. There are also schools, and as a main feature regular lectures each year, on subjects both technical and popular. The *Journal of the Franklin Institute*, was founded in 1826, and is consequently 68 years old. It is a standard publication, and a reference in which can be found a reliable record of progress in science and the industrial arts. From this old Institution—old for this country, has come more contributions to industrial and constructive art, than from any other association of like nature, and its future is as promising as the past.

In some recent investigations respecting water distribution where a tenth of the supply was measured by meters and paid for by quantity, and the other nine tenths was laid on, or supplied without checks. When the account was made up at the end of the season it was found that the tenth that passed through the meters paid 54 per cent. of the revenue. This may be an exceptional case, but there is no doubt that for every gallon consumed two are wasted in the common method of supply. The amount that is run into water closets under the delusion that it will "clean out the sewers" is a common cause of waste. A bucket full dashed into a water closet may clean out the pipes and do some good, but to open the service valve and let it run, does no good whatever. A small family can do very well with 100 gallons a day and should pay in proportion. In fact there is no just way to sell water except to measure it.

ENGINEERING NOTES.

Messrs. J. A. Fay & Co., of Cincinnati, Ohio, send an account of a band-saw mill of theirs at Holly, Mich., that has sawed 50,000 feet in ten hours, the work being accurate and of high class. The saws used were five inches wide on what the firm calls a No. 7 machine. Many of the older timbermen who read this will recall the sash saw mills of thirty years ago when 4,000 to 5,000 feet was a full day's work for a log man, two sawyers and an engineer. In 4,000 feet of timber sawn there was at least 1,000 feet board measure of sawdust, and the consumption of power, grease, belts, files and muscle was more for the old day's work than for the new one. Of average

width, and for one-inch boards, the length of kerf in the day's work of the band saw was about ten miles, and the feed, if operating three fourths of the time, about 12 feet per minute. It is marvelous if it has taken twenty-five years to find out how to do it.

E. L. Corthell, C. E., has for some time past, and almost alone so far as we can see, been promoting a scheme for founding an International Institute of Engineers and Architects which, if organized, would no doubt proceed to separate itself on the grounds of language, accessibility, and a dozen more reasons. It is hard, in this day of written records, to conceive of any reason of aggregation, on the contrary our educational economy demands segregation. The grounds upon which an international society would be based, as set forth by Mr. Corthell, are of a business nature, but it is easy to see that the main point and the result would be social. An essay, experiment or discovery, made here in San Francisco, the most isolated city in the world peopled by the Caucasian race, is or can be in all the chief centers of Europe in two weeks' time in a much more speedy way and at less expense than it could pass through a cumbrous international organization.

The problem of controlling the engines of steamers from the pilot house was recently discussed in a meeting of the Society of Naval Architects in New York. There is no difficulty in this when the machinery has been planned for that purpose. It is a common arrangement in the German and Baltic steamers and has been for a dozen years past. It is as easy to control and reverse an engine directly from a pilot house as it is to signal to an engineer, and centralizes such control where it belongs. It would not answer on our beam engine ferry boats where an engineer on duty and on the alert, is not sure if he can follow the signals without accident or mistake. It is near time when in the multiplicity of navigation rules and laws we had one prohibiting signal crank steamboats of all kinds. It would do away with a kind of acrobatic skill in which the engineers take some pride, but would save the piers and peoples' nerves.

The city of Duluth, Wis., rendered famous by Proctor Knott, of Kentucky, has on hand a water-power scheme that will, if carried out, change the whole character of the town. Duluth is at the head

of Lake Superior where traffic takes from land to water and the reverse, and is as Governor Knott says, equidistant from London, Paris, Berlin and St. Petersburg. The St. Louis river empties between there and Superior, the old port, and descends rapidly as it approaches the lake. It is proposed to divert this river thirty-four miles from Duluth, and convey the water by a canal to the top of the hills there, 600 feet above the lake, where it will be used for water power and all required purposes. The Minnesota Canal Company is to do this work, moving 3,000,000 cubic yards of material to form a canal 40 feet wide at the bottom, 120 feet at the top, and 20 feet deep. The water it is estimated will develop 140,000 horse power at Duluth. One must admire ideas of this size. The conception is something, if there is nothing more.

There was recently published in *Engineering*, London, fine drawings of the engines of the torpedo boat Daring, and when one comes to look at this machinery and consider its speed, it forms one of the greatest marvels of modern engineering and skill. The engines are triple expanding with cylinders 19 and 27 and two low pressure, 27-in. bore, with a stroke of 16 inches. To think of this mass of reciprocating parts performing 395 revolutions, and a piston speed of more than 1050 feet per minute, it seems incredible. The size of the crank shaft is not given, but the velocity in the bearings must be more than 600 feet per minute, or equal to a shaft two inches in diameter, revolving at the rate of 1600 revolutions per minute. An engine of 4842 horse power driven at this speed with a frame that collectively does not weigh as much as the steam in land practice.

The Babcock & Wilcox Company are now turning their attention to marine boilers, and it is quite time this was done in this country and in England also. This is one case where French practice in steam engineering has gone ahead of the Saxon. A large number of boilers in both countries have been supplied from France or made to French plans. M. Bellville, of Paris, at an early time, not less than twenty years ago, turned his attention to boilers "inexplosives," and has undoubtedly since then learned a great deal that others have to acquire, but the road should be easy now. The same remark applies to the Babcock & Wilcox Company in so far as stationary boilers, and both cases show the long and tedious road through which even a single element in steam engineering must pass.

Commodore Melville has this to say of the destruction of copper tubes in war vessels:

"The rapid destruction of copper piping in several vessels has already caused serious embarrassment, and the reason for this deterioration has not been determined to an absolute certainty. As it always happens that a copper pipe conveying or surrounded by salt water, as the injection or delivery pipe to a pump, or coil of a fresh water distiller, is the part attacked, and as the deterioration occurs only in steel ships fitted with dynamos, it is thought the injury may be caused by electrolytic action, since the copper of which the pipes are made is known to be of the very best quality, absolutely free from foreign matter, and therefore not affected by the corrosive action of salt water; in fact, precisely similar pipes, made of the same material, in iron vessels like the *Alert* or *Ranger*, which have no dynamos, last almost indefinitely.

Steps are being taken to find out the true cause of this rapid destruction and the means by which it may be prevented."

Mr. A. A. Pope, of Boston, has concluded to build a Mannesmann rolling plant at Hartford, Conn., to prepare tubes for the great bicycle works there, also for other purposes. This process, which has been extensively illustrated and explained in various journals, is a distinct and one of the most novel mechanical inventions of this age. It consists of rolling, or "pulling" is a better term, solid bars or ingots into tubes by a peculiar action inexplicable by words and involving strains that are nearly irresistible by any kind of gearing, and beyond the power of any motor such as is commercially possible. The power is, however, required only for a few seconds and is stored up in wire bound fly wheels to be let off like a charge of powder at the critical moment. It is a curious process and wonderfully expensive in so far as implements. We have not applied for any shares in the Pope Company.

ELECTRICITY.

NOTES.

The British Thomson-Houston Company, in England, has been reorganized, it is said with the especial view of engaging in railway construction in affiliation with the parent company in this country. The first contract assumed by the new company was the reconstruction of the Dublin Southern Lines in Ireland, for the Imperial Tram-

ways Company. Skilled men have been sent out from the American works, and the business gives promise of rapid extension. The Dublin contract will amount to \$350,000, and other extensive undertakings are in hand. As a rule, or as a history rather, American enterprises at first fail in England. The methods of business there are quite different, and it is only after some years of experiment, and commonly failure, that British branches succeed. The same thing is true in another sense, of living in England. It requires some years to learn how to live there and be comfortable.

As it is conceded that an electrically-propelled street car can be stopped in its length, no hardship can arise from some regulation that requires brake provision for that purpose. The fact is, however, that brake apparatus is just now a good deal behind, and there seems to be much sound suggestion in a paper read at the late meeting of the American Street Railway Association, at Atlanta, Ga., by Mr. E. J. Wessels, in which air brakes for street-railway service were recommended. We do not refer to any scheme or method proposed by the author, or anyone else, but to the analogy between street and other railway service. If air is good in one case, why not in the other? It would be a good plan if people experienced in this line of business, like the Westinghouse Company, would take up this matter and supply outfits, including compressors to be geared to the propelling motors of electrically-driven cars.

It is significant to observe how much of the proceedings at the Atlanta Convention of the Street Railway Association was devoted to electrical problems and apparatus. No doubt this was mainly due to the energy that characterizes this industry at the present day, but making all allowance for this it would seem that other methods of propulsion are in danger of extinction. One paper was read on the use of supplementary generators, called by the euphonious name of "Booster." We hope never to have occasion again to print this name, and think the authorities on electrical terminology should suspend the inventor. By graphic and computed data the authors, Messrs. Vail and Wyncoop, made out a case which scarcely admits of question as to the economy of investment derived from the reinforcing system of feeding along the course of a line instead of starting out with wires large enough to carry the whole current from a central station.

The way to make an "electric journal" now-a-days seems to be to include that term in the title. What it means beyond "news," and reprinted extracts, is not easy to determine. A journal to deal with electric science, and its problems, requires a staff and resources which few can pretend to or maintain, and anything less is a kind of caricature. The scope and function of a name should be confined to distinguishing a journal, or anything else, from others of its kind, and when technical, the class to which it belongs. Electric matters and interests constitute a branch of modern engineering, and is so described in terms of present usage. "Electrician" has nearly disappeared, and will altogether before long. One who is an "electrician" must be a good deal more. His qualifications and efforts must include mechanics and applied sciences in their various phases, and it is time that electric science and its arts were included in the general terms that include technical learning.

The Electrical Engineering Company, of this City, is busily engaged on mining apparatus and machinery, and are also adding to their facilities in order to "keep up." Two sixty horse power motors, and a generator of one hundred and fifty horse power, have gone to the Empire Mine, Sierra County. A plant for the Phoenix Mine has also been sent forward; also a pumping outfit to the Taylor Mine in Eldorado County. We had prepared to use illustrations of these machines for the present number, but they have been shut out for want of space. Next month we hope to illustrate something of the practice of this company, which is the only one making heavy electrical apparatus on this Coast. Their practice is original and peculiar, especially in their methods of controlling motors, and maintaining uniform speed under all variations of load.

Judge Lacombe, of New York, has rendered a decision in a case between the Accumulator Company of New York, plaintiffs, and the Edison Electric Illuminating Company, adverse to the defendants, and declaring the methods of the Chloride Company to be an infringement of the Swan patent, owned by the Accumulator Company. That the Chloride Company have improved the batteries is hardly to be doubted, and a much better authority than Judge Lacombe on technical matters, the Committee on Arts and Sciences of the Franklin Institute, have awarded a medal to the inventor

ELECTRICAL NOTES.

of the chloride batteries, claiming that the methods embrace advantages not found in previous practice. When these patent quibbles disappear, if ever, the manufacture of storage apparatus will settle down in some form to be more widely available. The money spent in law suits would if applied to improving the batteries have done a deal more good.

The General Electric Company have in some late designs reduced electric winding gearing for mines to a very simple system, apparently dispensing with a good deal of the usual details common in such machinery. An engraving of one of these new hoists was not received in time for publication in this issue, but will appear in the next. Electricity in mining as a theme for essays has become a joke, the harp of a thousand strings, so to speak, devoted to the ideal, harmless and nearly useless, but all the time some hard-working people, with but little to say, have been inventing and making things to that end. The advance has been in adaptation, actual construction and experiments. The work has been carried on with lessons and gains, a little here, and a little there, until the owner of a mine can now with assurance and safety introduce various electrical elements into his works.

S. Dana Greene, late an officer in the United States Navy, has prepared an essay on "Electricity on Shipboard" that, besides being a scholarly presentation of the subject, indicates that with all the attendant difficulties the adaptation on shipboard is quite as advanced as on land. The various circumstances and requirements of such use are discussed under different heads, ending with steam turbines, which have the endorsement of the author, but without mention of their present use on some of the Atlantic line steamers. This progress in electrical applications on shipboard, and the character of the present paper, are indications that the people on land must look to their laurels, or, as in steam engineering, they will have to take lessons from the sea. There is an especial activity at this day in all that pertains to marine engineering work.

The John Scott legacy, premium and medal have been awarded by the Franklin Institute, of Philadelphia, to Mr. Clement Payne for his invention of the chloride accumulator batteries, the Committee on Arts and Sciences deciding that these batteries contain or embody

certain features that constitute a distinct improvement over previously known types of cells. It is a curious thing that people on this Coast, where there have been many meritorious inventions, have not applied for awards by the Franklin Institute. The examinations into the merits of new and useful invention are made in a thorough and impartial manner, and the honor and value of such awards make them an object of the highest importance. We could pick out half a dozen meritorious inventions here that could be presented for this purpose, and hope in future to see more interest in the matter.

MINING.

NOTES.

We will soon see if the *Engineering and Mining Journal's* estimate of novelty in the McArthur-Forrest cyanide process was correct or not. If we remember correctly the want of novelty in these patents was asserted some years ago and some forecasts made as to the scope of its useful application, the latter to some extent wrong, but the novelty part has been sustained by an adverse court decision in England that will have a good deal of influence here if the same issue is raised. There is a rule for this country that patentees should remember: namely, that the practical life of a patent or an invention in the industrial arts lasts so long as the royalties imposed are as profitable to the maker or user as they are to the inventor. This is no doubt a difficulty that the "cyanide" company labor under. In Europe it is different; large royalties may run for the legal term of a patent, but seldom do in this country.

The people in Colorado expect this year to run California very close on gold production. This is remarkable, all things considered, and is not creditable to California, perhaps is not possible, and if possible is owing to an easier command of capital in Colorado. Denver, the center of mining business for the State, is only 600 miles west of the Missouri River and is in effect an Eastern or Middle State city, besides has the advantage of being settled with a class of wealthy, energetic men who put their money into mines and cattle, and attend to their investments. They had a Leadville as we had a Comstock to demoralize what may be called normal mining, but the effect in Colorado was less and sooner over.

We have been informed that pumping machinery made under the Riedler patent has to be furnished, because of patent royalties, at a large advance in price over what other standard pumps of like capacity are sold for. If this is the case the system will not last long in this country. An inventor is entitled to what his invention produces and no more. If with the Riedler improvements, pumps of a smaller size and cost will perform a given work, then the difference in cost to construct is the inventor's legitimate profit, because price should follow capacity. If a new method insures great economy, that also becomes a consideration, one that should be paid for over a period, or the result guaranteed with responsible recourse in case of failure. Under unfair or excessive royalty we predict that the Riedler system of pumps will have little value in this country three years hence. Such is the history of all cases of this kind.

The tail end of the Western Australia mining excitement has switched around here, so to speak. Its head in London is less vigorous, and it would be as well if people setting out for this distant land would wait for a time for things to settle. With the resumption of business will come such a horde of visionary schemes that we may look for a long period in which promoters and fakes will destroy confidence. They are hungry now, and while gold may have been found in promising quantities in Western Australia no one need look for a fair representation of the matter. The best place for California people to invest their energy and capital is in old mines of their own State, or new ones on lodes that have been explored. The interior of Australia, or rather the Western side, will undoubtedly be found to contain auriferous regions, but a reported \$85,000 taken out of a hole three feet deep is "starting in too strong."

The Standard Consolidated mines of Bodie, as announced from New York, are in position to declare a dividend of 10 cents per share, which no doubt means a good deal more because the company is about to extend its plant, and Mr. Leggett is conservative enough to hold on to money for that purpose. The California and Virginia, Comstock mine, has declared a dividend of 25 cents per share, the first in three years, and the Best and Belcher have inverted this by an assessment of an equal amount. On the whole the Comstock shares are "up" it being up means anything. At the late Convention and elsewhere it has been asserted that mining is the most

prosperous industry in California at the present time, and this is undoubtedly true, because an ounce of gold is worth as much or more than it was before the dull times, while other products of industry, some of them, are worth about half as much.

In the late Mining Convention the proceedings that most commended themselves to the general public are those relating to Federal legislations as affecting mineral laws. The argument submitted to the convention by the Hon. T. L. Ford, Judge E. A. Belcher and Mr. Charles G. Yale on the determination of mineral and agricultural lands, and in support of a section of the famous Newland's Bill, is an especially interesting document and presents a subject coming fairly within the province of the convention to consider. In an address by Mr. A. H. Ricketts on the rulings of the Land Department, he said at the end of his remarks :

"The extraordinary attitude of the Land Department toward the miner can not be too strongly condemned. Its power in the matter of the disposition and selection of the public lands must be curtailed. Its usurped power to legislate and practically repeal the Act of Congress by so-called regulations and circular instructions must be taken from it. Its power to favor one class of land claimants more than another must be wholly done away with."

Consul General D. W. Maratta at Melbourne, Australia, sent in August last a long communication to the Department of State on the "Mining Industries of Australasia," and says in respect to Western Australia :

"There is a good opportunity here for miners from the United States well versed in the best methods of obtaining gold, but it is absolutely necessary that they come well provided with both funds and experience, with sufficient of the former to last them at least six months, irrespective of what gold they may obtain. The machinery and appliances in vogue here are not altogether the latest and best—in many cases they are quite obsolete. If some of our large manufacturers of mining machinery and appliances would send representatives out to these colonies, it would, in my opinion, well repay them."

An extensive treatise on gold mining in Africa has been issued in Germany and should be translated into English. The German people are careful in statistics and the treatise is no doubt one of great interest. A reviewer says the development of gold mining in the

Transvaal exceeds anything of the kind elsewhere in the world, and this it seems has been done with all the regularity and order of advanced civilization. Johannesburg, the center of this great industry, is well built and thoroughly organized, an orderly city, electrically lighted and in all respects the peer of any European town of its size. The methods of mining are advanced and full advantage has been taken of all experience that has gone before. The main thing, however, is the reign of law and the absence of the loose and barbaric features that have at first attended gold finding in this country and in Australia. The Dutch element has to do with this. No nation is better governed, and rowdiness is not known in their land.

DETAILS.

A correspondent wants to know how the "notes" in INDUSTRY are made so nearly the same length. The answer is that the editor is furnished with foolscap paper, and the compositors set up each sheet by itself—a necessity growing out of the fact that the pages are not numbered.

A dry kind of compositor in the absence of the foreman carried his copy into the editor's room with a query in some electrical matter, a mere excuse, because he remarked on going out: "Queer thing that old Noah got into electrical business." A stare. Answer: "He made an 'ark light' on Mt. Ararat." Discharged.

What would any other government in the world, except Russia, do with free Finland on one side and Tartary on the other, to be governed from one center. Not one of the usual "government machines" would last twelve months. Could they bring cosmos out of chaos, or produce homogeneity out of Scandinavian, Lutherans, Greek Slavs and Tartar Mohammedans?

The only reasonable remarks upon the new ruler of Russia we have seen were by Mr. Ambrose Bierce, who rated Lord Roseberry, the English Premier, for differing from the *Landofredum Magazine* in its estimate of the late Czar. The fact is we know next to nothing at all concerning Russia, but may know more some time. Napoleon said: "In a hundred years Europe will be Republican or Cossack." The hundred years have some time to run yet.

People want a new railway in the San Joaquin Valley. The resources of that rich district will, no doubt, support another line, perhaps a third one some time, if the rates are increased, and the farmers are content to support the railways. A canal through the valley would be worth a dozen railways in so far as freight, but every one could use it, and there would be no monopoly. The business man of our time abhors anything "free," the very word is obnoxious.

The battle ship *Maine*, built at the U. S. Brooklyn Navy Yard, was tried in October. The speed on the four-hour run was about 17 knots an hour with 9,300 horse power. The engines were made by the Quintard Iron Works, New York, and exceeded the contract capacity 300 horse power, and a premium of \$30,000 is to be paid for that result. This is \$100 a horse power for filling the contract to the specification.

The use of pulverized coal has broken out in Germany as fuel for steam boilers. 5,738 pounds of pulverized coal did as much work as 7,085 pounds of lump coal, and should have done a good deal more to pay for grinding the fuel. Pulverizing coal is not a cheap process. It has been tried in this country, many years ago, twenty-five at least, and did well until the grinding bill came in, then the scheme ended.

A good many will be puzzled in reading about the great Austin dam on the "Colorado River." Not one in ten in this part of the world knows there is a Colorado River in Texas. It is bad enough to have towns of the same name scattered all over the country, but when it comes to calling two rivers in the same division of the country by one name it is time to protest. The Texas Colorado River rises in the Indian Territory, and empties into Matagorda Bay, about the middle of the Texas coast.

The Government Commission appointed to inquire into the Pullman strike have made their report to the President, and any impartial reader must conclude that the showing for the Pullman Company is discreditable. With all the advantages that sophistry, the power of wealth, and sympathy the employing powers could give, the case stands out as an example of pretended paternalism, organized and conducted on selfish lines. The company has paid eight per cent. dividends since 1857, and besides has accumulated a surplus of \$25,000,000 since then.

The officers of the Union Iron Works, we learn, are to urge the next Legislature of California to some kind of regulation to relieve ships from paying municipal taxes for sewers, street cleaning, fire apparatus, and the like, also to permit vessels to come to the ends of the streets without a daily fine for landing there, and for some distinction between a vessel under construction and one in regular service. The first thing should be to present each member with a copy of "Wells Merchant Marine," and stop his salary until the book is read.

The Australian system of voting is a most cumbersome one, but good withall, and necessary on a dozen grounds, but needs improvement in counting the ballots, also perhaps in many other ways, but the method of counting wholly through a ticket at one time is essentially wrong. One column, or one set of candidates, should be called at a time so the ballot clerks would not have to "turn over," also could keep the names in ready memory.

It is now in order for someone to invent a machine to perform seven eighths of the processes involved in this Australian system of voting. The purpose is to transfer to a tally sheet the marks that a voter makes opposite the names of candidates of his choice, and the manner of doing this is very much like the Chinaman's method of roasting a pig, described by Charles Lamb. The first one was cooked in the burning of a house, and it was ever afterwards thought necessary to burn down someone's house when a pig was to be roasted.

In a recent argument respecting early locomotives in this country, we recently heard the remark that two or three were imported, but were soon superseded. Now it makes no difference whether engines were brought from England here, or taken from here to England, the more the better each way in so far as improving the art, but the truth must be considered. Between 1828 and 1837, a period of nine years, Messrs. Stephenson, of New Castle, sent thirty-nine, and Edward Berry & Co., of Liverpool, twenty locomotives, to this country, making fifty-nine from these two firms.

The copper mines on Lake Superior are distancing all other "holes" in this country. A recent list of the depth of mines there runs as follows: 3,240 feet, 3,330 feet, 4,250 feet, 4,420 feet. The

ultimate depth in contemplation is 6,000 feet, or 1.11 miles. The winding drums used are 36 feet diameter in the center, 13 feet 6 inches at the ends, for 600 feet of rope at each side. The engines are, in one case, 32 inches bore by 84 inches stroke, and the speed of hoisting is 4,000 feet per minute with loads of three tons. This, we imagine, far exceeds any other example in this country.

The "Holman locomotive" consists of a double set of rollers placed on the rails under the driving wheels so as to increase the rate of progression for a given piston speed. It would be a waste of space to criticise such a thing, but some comment is due on the publication and illustration of the locomotive and "rig" in the *Railway Review*. The editor must know it is clotted nonsense, impossible on mechanical grounds, and a freak on all other grounds. A portrait of the inventor would have more interest.

The election is over, and in so far as it applied to executive officers is illogical, and an offense against common sense. In so far as legislative officers it is logical and wise, or a necessity at this day, but to select and elect by a "party" a man to be a judge, or any other officer to perform stipulated functions, is one of the queer things in this world. It means or implies that executive offices are favors to be traded around, a thing to be sought by all kinds of men, qualified or otherwise.

By a late parliamentary publication in England it seems that the chemical treatment or precipitation of town sewage has been adopted in all the interior towns, indeed is unavoidable, as such material can not be emptied into streams. There are between fifty and sixty cases mentioned in an abstract published in the *Engineer* that show a wonderful diversity of methods or of chemical reagents employed for precipitation with nearly the same result in so far as the resultant product. This latter in only a few cases is sold at a profit and in much the larger number of cases is given away and glad of the chance. We examined some years ago a very ingenious system for the disposal of sewage for the town of Altrincham, near Manchester in England. The local board acquired some "moss land," a kind of bog that is like peat. This was drained, laid off into squares or sections with water channels at short distances. The land was planted with willows and the cuttings sold for \$30 per acre each season. The solids of the sewage were removed and treated before the water reached the "osier" farm.

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